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59TH CONGRESS : : 1ST SESSION

DECEMBER 4, 1905–JUNE 30, 1906

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CHARLES D. WALCOTT, DIRECTOR

# REPORT
OF
# PROGRESS OF STREAM MEASUREMENTS
FOR
# THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART IX.—Meramec, Arkansas, Red, and Lower Western Mississippi River Drainages

BY

**M. C. HINDERLIDER, J. M. GILES, and J. C. HOYT**

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1906

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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART IX.

By M. C. HINDERLIDER, J. M. GILES, and J. C. HOYT.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semi-arid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

*Annual appropriation for hydrographic surveys for fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years, the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

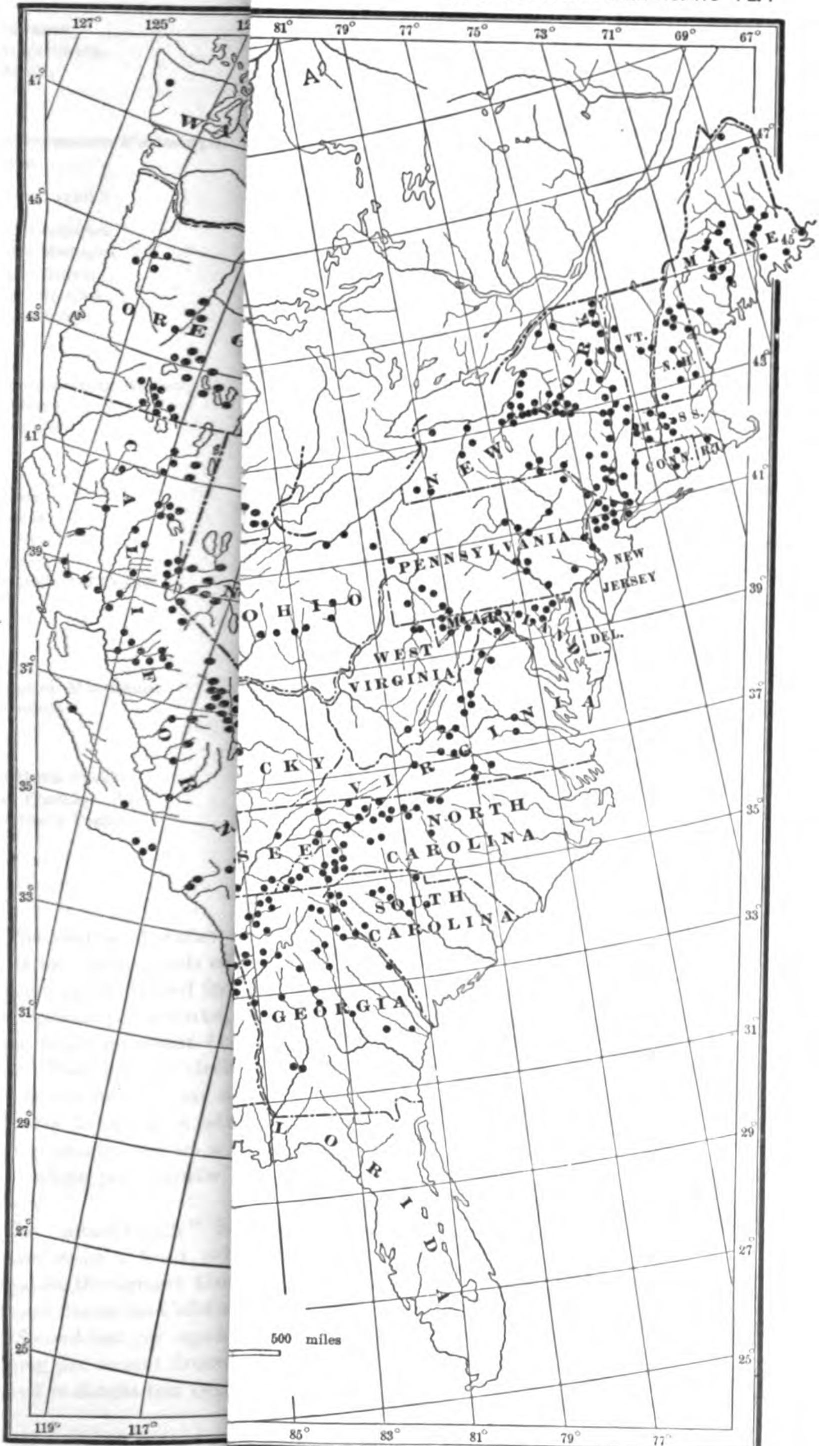
*List of drainage basins in the United States.*

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor southern Atlantic.


127°
125°
81°
79°
77°
75°
73°
71°
69°
67°
47°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
119°
117°
85°
83°
81°
79°
77°
A
WA
OREG
CALIFORNIA
N
OHIO
WEST VIRGINIA
VIRGINIA
UCKY
SEE
NEW YORK
PENNSYLVANIA
NEW JERSEY
MARYLAND
DEL.
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
LORIDA
500 miles

DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadelupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS.

## DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most Stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

*Special rules for computation.*

1. Rating tables are to be constructed as close as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; 0.125; 0.012; 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers one square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-feet.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equals about 1 kilowatt.
To calculate waterpower quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = Net horsepower on water wheel, realizing 80 per cent of the theoretical power.
Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; $l$ = length of weir in inches; $h$ = head in inches flowing over weir, measured from surface of still water.
To change miles to inches on map:
Scale 1 : 125,000, 1 mile = 0.50688 inch.
Scale 1 : 90,000, 1 mile = 0.70400 inch.
Scale 1 : 62,500, 1 mile = 1.01376 inches.
Scale 1 : 45,000, 1 mile = 1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given.

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$ which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (See Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

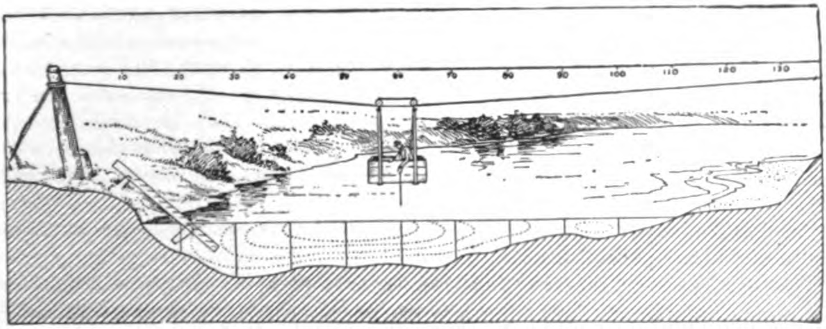


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channnel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float observation is made of the time taken by the float to pass over the "run"—a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type so constructed that the impact of flowing water causes it to revolve and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical-velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, 4 times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained is 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the "subsurface" method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross-sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge varying thickness of ice. Such data as are available in regard to this subject are published in Water Supply paper No. 146, pages 141-148.

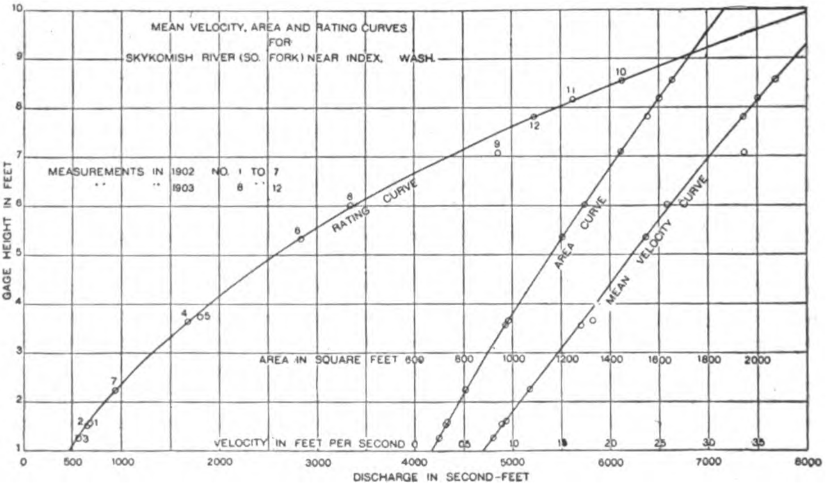


FIG. 2—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations of streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measurning flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross-section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

*Arkansas.*—District hydrographer, Thomas U. Taylor.[a]

*Colorado.*—District and resident hydrographer, M. C. Hinderlider,[b] assisted by R. I. Meeker, Wm. A. Lamb, H. G. Graham, A. A. Weiland, O. H. Timmerman, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgements are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, Union Pacific, Rio Grande Southern, and Atchison, Topeka and Santa Fe railroads for free transportation over their lines.

*Kansas.*—District hydrographer, M. C. Hinderlider, resident hydrographer, W. G. Russell Acknowledgments are due the Atchison, Topeka, and Santa Fe; Union Pacific; Missouri, Kansas and Texas; Missouri Pacific; and Chicago, Rock Island and Pacific railroads for annual passes issued to Mr. Russell.

*Missouri.*—District hydrographer, F. W. Hanna,[c] assisted by M. S. Brennan and S. K. Clapp. Acknowledgment should be made to the St. Louis and San Francisco Railroad for transportation furnished to Messrs. Hanna and Brennan.

*New Mexico.*—[d] The hydrographic work in the northern portion of this territory was carried on under the direction of M. C. Hinderlider, district hydrographer, assisted as follows: The work in the north-central portion was in charge of R. I. Meeker and the work in the northernwestern portion was in charge of O. H. Timmerman. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of La Cueva, N. Mex.; also to James D. Hand, of Los Alamos, N Mex. Transportation in the form of annual passes was furnished Mr. Meeker by the Denver and Rio Grande and the Atchison, Topeka, and Santa Fe railroads.

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*Oklahoma and Indian Territory.*—The work in the southern part of Oklahoma and Indian Territory was under the direction of J. M. Giles, district hydrographer, assisted by Earl Patterson and E. R. Kerby. The work in the northern part was by W. G. Russell, resident hydrographer. Acknowledgments are due the Atchison, Topeka and Santa Fe; Missouri, Kansas and Texas; and Chicago, Rock Island and Pacific railroads for transportation furnished Mr. Russell; to the Southern Kansas of Texas; Chicago, Rock Island and Pacific; St. Louis and San Francisco; Fort Worth and Denver City; and Texas and Pacific railroads and Pecos Valley lines for transportation furnished Mr. Giles; to the Chicago, Rock Island and Pacific; and the St. Louis and San Francisco railroads for transportation furnished Mr. Kerby; and to the Southern Kansas of Texas and the Pecos Valley lines for transportation furnished Mr. Patterson.

*Texas.*—District hydrographer, Thomas U. Taylor.

## MERAMEC RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Meramec River rises in Dent County, Mo., flows northeast, and enters the Mississippi near St. Louis. This river drains a rugged, hilly, and comparatively thinly populated country, There are, however, numerous good sites for dams, and the United States Geological Survey is studying the river in connection with the possible water-power developments and for its possible use as a future water supply for the city of St. Louis.

The total drainage area of Meramec River is 3,619 square miles; at Eureka it is 3,497 square miles. The drainage area above Dry Fork is 340 square miles, and that of Dry Fork is 360 square miles.

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[a] Office of the district hydrographer for Arkansas, Texas, and Louisiana, Austin, Tex.

[b] Office of district hydrographer for Colorado Kansas, Nebraska, northern New Mexico, and Wyoming. Chamber of Commerce Building, Denver, Colo.

[c] District hydrographer for Missouri during 1906, A. H. Horton, 876 Federal Building, Chicago, Ill.

[d] District hydrographer for southern and eastern New Mexico, southern Oklahoma, and southern Indian Territory, J. M. Giles, Carlsbad, N. Mex.

## MERAMEC RIVER NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located about 600 feet below the mouth of Spring Branch and about 1 mile from the post road between Meramec and St. James, Mo. The nearest railroad station is St. James, 7 miles northwest of the gaging station. The drainage area at this station is 340 square miles.

The channel is straight for about 300 feet above the station and for 2,000 feet below. The current velocity is sufficient for accurate measurement except at low stages, when it becomes sluggish. Both banks are low, and at high water the river spreads over wide flats. The bed of the stream is shifting.

Discharge measurements are made by means of a cable, boat, and tagged wire. The initial point for soundings has been taken at the tree to which the cable is attached on the left bank. At low stages measurements are obtained by wading the river about 200 feet above the mouth of Meramec Spring and adding to this discharge the flow of Meramec Spring.

The gage is a staff driven into the bed of the river and nailed at the top to a leaning tree. During 1905 the gage was read by C. C. Smallwood. The bench mark is a point on a bowlder on the left bank at the foot of the cliff near the mouth of Spring Branch; elevation, 10.44 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 99, p 233; 131, p 118.
**Discharge**: 99, p 234; 131, p 119.
**Discharge, monthly**: 99, p 235.
**Gage heights**: 99, p 234; 131, p 119.
**Rating tables**: 99, p 235.

*Discharge measurements of Meramec River near Meramec, Mo., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| June 22 | M. S. Brennan | 2.79 | 164 |
| July 26 | do | 3.60 | 438 |
| September 8 | do | 2.79 | 168 |
| October 12 | do | 2.92 | 174 |
| December 20 | do | 2.96 | 256 |

*Daily gage height, in feet, of Meramec River near Meramec, Mo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.75 | 2.75 | 4.5 | 4.4 | 3.7 | 3.0 | 3.1 | 3.4 | 2.9 | 3.3 | 3.7 | 3.1 |
| 2 | 2.75 | 2.75 | 4.1 | 4.1 | 3.6 | 2.9 | 3.1 | 3.3 | 2.9 | 3.2 | 3.6 | 3.6 |
| 3 | 2.75 | 2.75 | 3.9 | 3.9 | 3.5 | 2.9 | 3.0 | 3.2 | 2.8 | 3.1 | 3.5 | 3.8 |
| 4 | 2.75 | 2.75 | 3.8 | 3.7 | 3.4 | 3.0 | 3.0 | 3.1 | 2.8 | 3.1 | 3.5 | 3.6 |
| 5 | 2.75 | 2.75 | 3.8 | 3.6 | 3.4 | 2.9 | 2.9 | 3.0 | 2.8 | 3.1 | 4.9 | 3.5 |
| 6 | 2.75 | 2.75 | 5.1 | 3.6 | 3.3 | 2.9 | 2.9 | 3.0 | 2.8 | 3.0 | 4.8 | 3.4 |
| 7 | 2.75 | 2.75 | 7.2 | 3.5 | 4.6 | 2.9 | 2.8 | 3.4 | 2.8 | 3.0 | 4.3 | 3.3 |
| 8 | 2.75 | 2.75 | 8.0 | 3.4 | 4.1 | 2.8 | 2.8 | 3.3 | 2.8 | 3.0 | 4.1 | 3.2 |
| 9 | 2.75 | 2.75 | 6.4 | 3.3 | 4.0 | 2.8 | 2.9 | 3.2 | 2.8 | 3.0 | 4.1 | 3.1 |
| 10 | 2.75 | 2.75 | 5.0 | 3.3 | 3.8 | 2.8 | 3.2 | 3.1 | 3.0 | 3.0 | 3.7 | 3.05 |
| 11 | 2.75 | 2.75 | 4.8 | 3.6 | 3.8 | 2.8 | 4.5 | 3.3 | 2.9 | 2.95 | 3.6 | 3.0 |
| 12 | 2.75 | 2.75 | 4.4 | 3.6 | 3.8 | 2.8 | 3.7 | 3.0 | 2.8 | 2.9 | 3.5 | 3.0 |
| 13 | 2.75 | 2.75 | 4.1 | 3.6 | 3.7 | 2.8 | 3.6 | 3.0 | 2.8 | 2.9 | 3.4 | 3.0 |
| 14 | 2.75 | 2.75 | 3.9 | 3.4 | 7.2 | 2.8 | 3.4 | 2.9 | 1.8 | 2.9 | 3.3 | 2.95 |
| 15 | 2.75 | 2.75 | 3.8 | 3.3 | 4.8 | 2.8 | 3.3 | 3.4 | 1.8 | 2.9 | 3.3 | 2.95 |
| 16 | 2.75 | 2.75 | 3.7 | 3.1 | 4.4 | 2.8 | 3.2 | 3.1 | 2.75 | 2.9 | 3.3 | 2.9 |
| 17 | 2.75 | 2.75 | 3.7 | 3.1 | 4.2 | 2.8 | 3.0 | 3.0 | 7.0 | 2.9 | 3.2 | 2.9 |
| 18 | 2.8 | 2.75 | 3.5 | 3.1 | 4.0 | 2.8 | 3.0 | 3.0 | 8.2 | 2.9 | 3.2 | 2.9 |
| 19 | 2.8 | 2.8 | 3.5 | 3.0 | 3.8 | 2.8 | 2.9 | 3.0 | 7.8 | 3.6 | 4.7 | 2.9 |
| 20 | 2.9 | 2.8 | 3.5 | 3.0 | 3.5 | 2.7 | 2.9 | 2.9 | 6.0 | 3.4 | 4.9 | 2.95 |
| 21 | 2.9 | 2.9 | 3.4 | 2.9 | 3.4 | 2.9 | 6.9 | 2.8 | 5.6 | 3.3 | 4.3 | 2.95 |
| 22 | 3.1 | 3.0 | 3.4 | 2.9 | 3.4 | 2.7 | 6.1 | 5.4 | 5.1 | 3.2 | 3.9 | 2.95 |
| 23 | 3.1 | 3.9 | 3.4 | 2.9 | 4.0 | 2.7 | 4.8 | 4.2 | 4.3 | 3.1 | 3.7 | 3.0 |
| 24 | 3.1 | 4.0 | 3.5 | 2.9 | 3.9 | 2.7 | 4.0 | 3.9 | 4.2 | 3.6 | 3.6 | 3.0 |
| 25 | 3.0 | 5.6 | 3.6 | 2.9 | 3.6 | 2.8 | 3.7 | 3.8 | 3.9 | 4.4 | 3.5 | 3.0 |
| 26 | 2.9 | 5.3 | 3.4 | 4.1 | 3.5 | 2.9 | 3.6 | 3.4 | 3.7 | 5.9 | 3.4 | 2.95 |
| 27 | 2.9 | 5.9 | 3.4 | 4.0 | 3.4 | 2.9 | 3.7 | 3.1 | 3.5 | 4.0 | 3.3 | 2.95 |
| 28 | 2.8 | 4.6 | 3.3 | 3.8 | 3.4 | 2.9 | 3.7 | 3.1 | 3.4 | 3.9 | 3.3 | 3.0 |
| 29 | 2.75 | ....... | 3.6 | 3.8 | 3.3 | 3.1 | 3.7 | 3.0 | 3.4 | 3.9 | 3.2 | 3.4 |
| 30 | 2.75 | ....... | 5.3 | 3.8 | 3.4 | 3.1 | 3.4 | 3.0 | 3.3 | 3.9 | 3.2 | 3.3 |
| 31 | 2.75 | ....... | 4.9 | ....... | 3.1 | ....... | 3.4 | 2.9 | ....... | 3.8 | ....... | ....... |

## MERAMEC RIVER NEAR EUREKA, MO.

This station was established August 26, 1903, by F. W. Hanna. It is located at the highway bridge on the road between Crescent and Eureka, Mo., about 1½ miles from Eureka, 2 miles below the mouth of Big River, and 2 miles above the Frisco Railroad bridge.

The channel is straight for about 250 feet above and 1,000 feet below the station. The right bank is high and rocky and not subject to overflow. It is wooded above the high-water line. The left bank is somewhat lower and is composed of alluvial soil, and it also is wooded above the high-water line. The bed of the stream is composed of coarse gravel and stones. The current is never sluggish. There is but one channel, and it is broken by the center pier of the bridge.

Discharge measurements are made from the two-span highway bridge with a length between abutments of 450 feet. The initial point for soundings is the inner face of the right abutment on the upstream side.

A standard chain gage is attached to the floor of the bridge; length of chain, 42.46 feet. During 1905 the gage was read by Mrs. Rhoda Hilderbran. Bench marks were established as follows: (1) A notch cut into the high rock cliff just below the bridge, marked by a painted cross and the letters "U. S. G. S.;" elevation, 38.26 feet. (2) A red mark on the top of the downstream guard rail, just above the gage box; elevation, 42.56 feet.

(3) A painted cross, surrounded by the letters "U. S. G. S," on the lower wing of the left abutment; elevation, 36.29 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 240; 131, p 120.
Discharge: 99, p 240; 131, p 120.
Discharge, monthly: 99, p 242; 131, p 123.
Gage heights: 99, p 241; 131, p 121.
Rating table: 99, p 241; 131, p 122.

*Discharge measurements of Meramec River near Eureka, Mo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 6 | M. S. Brennan | 193 | 739 | 3.98 | 5.55 | 2,944 |
| May 13 | S. K. Clapp | 223 | 932 | 4.16 | 6.05 | 3,881 |
| June 21 | M. S. Brennan | 189 | 624 | 3.47 | 4.74 | 2,167 |
| July 25 | do | 245 | 1,212 | 3.88 | 7.30 | 4,700 |
| September 7 | do | 151 | 372 | 2.11 | 3.35 | 784 |
| October 11 | do | 145 | 422 | 2.69 | 3.80 | 1,136 |
| December 19 | do | 161 | 491 | 2.84 | 4.14 | 1,3[illegible]6 |

*Daily gage height, in feet, of Meramec River near Eureka, Mo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.1 | 4.1 | 10.8 | 9.4 | 8.5 | 5.8 | 4.0 | 4.5 | 3.9 | 4.6 | 6.9 | 5.0 |
| 2 | 3.1 | 4.0 | 9.8 | 7.7 | 6.9 | 6.0 | 5.4 | 4.3 | 4.0 | 4.5 | 8.4 | 5.1 |
| 3 | 3.1 | 3.7 | 8.3 | 7.0 | 5.7 | 4.8 | 7.2 | 4.1 | 4.0 | 4.4 | 7.2 | 7.0 |
| 4 | 3.0 | 3.7 | 7.5 | 6.4 | 5.4 | 4.4 | 6.4 | 4.0 | 3.8 | 4.3 | 6.3 | 6.4 |
| 5 | 3.0 | 3.8 | 6.7 | 6.0 | 6.0 | 4.1 | 5.5 | 4.0 | 3.5 | 4.2 | 7.5 | 6.1 |
| 6 | 3.1 | 3.9 | 6.2 | 5.6 | 5.8 | 4.0 | 4.7 | 3.9 | 3.3 | 4.1 | 8.8 | 5.8 |
| 7 | 3.2 | 3.9 | 6.3 | 5.3 | 10.2 | 3.8 | 4.5 | 4.1 | 3.3 | 4.0 | 10.7 | 5.4 |
| 8 | 3.2 | 3.8 | 15.4 | 5.1 | 8.3 | 3.7 | 4.5 | 4.1 | 3.4 | 3.9 | 8.7 | 5.2 |
| 9 | 3.2 | 3.9 | 19.8 | 5.0 | 7.6 | 3.6 | 4.7 | 4.0 | 3.5 | 3.9 | 7.3 | 5.0 |
| 10 | 3.1 | 3.9 | 19.6 | 4.8 | 7.8 | 3.5 | 4.8 | 3.9 | 3.9 | 3.8 | 6.6 | 4.9 |
| 11 | 3.0 | 3.8 | 17.5 | 5.6 | 8.5 | 3.5 | 7.0 | 3.7 | 4.2 | 3.8 | 6.0 | 4.8 |
| 12 | 3.6 | 3.8 | 9.7 | 6.8 | 7.0 | 3.5 | 10.7 | 3.7 | 4.0 | 3.7 | 5.5 | 4.7 |
| 13 | 4.2 | 3.8 | 8.0 | 6.4 | 6.0 | 3.4 | 7.5 | 4.1 | 4.2 | 3.6 | 5.3 | 4.6 |
| 14 | 5.0 | 3.7 | 7.3 | 5.9 | 6.9 | 3.4 | 7.7 | 4.0 | 4.0 | 3.6 | 5.1 | 4.5 |
| 15 | 4.9 | 3.6 | 6.5 | 5.6 | 7.8 | 3.4 | 7.1 | 4.0 | 3.8 | 3.6 | 4.9 | 4.4 |
| 16 | 4.7 | 3.6 | 6.0 | 5.3 | 9.4 | 3.4 | 6.6 | 4.0 | 4.9 | 3.6 | 4.8 | 4.3 |
| 17 | 4.5 | 3.6 | 5.7 | 5.0 | 7.3 | 3.3 | 5.4 | 4.1 | 18.4 | 3.6 | 4.7 | 4.2 |
| 18 | 4.5 | 3.6 | 5.5 | 4.8 | 6.0 | 3.3 | 4.8 | 4.5 | 20.9 | 4.3 | 4.5 | 4.2 |
| 19 | 5.2 | 3.7 | 5.4 | 4.5 | 5.8 | 3.2 | 4.5 | 4.7 | 24.5 | 4.5 | 5.4 | 4.2 |
| 20 | 5.9 | 3.7 | 5.2 | 4.3 | 5.2 | 3.4 | 4.4 | 4.5 | 29.7 | 7.2 | 10.0 | 4.1 |
| 21 | 6.2 | 3.7 | 5.0 | 4.4 | 4.9 | 4.7 | 5.2 | 4.3 | 28.5 | 6.2 | 12.2 | 4.1 |
| 22 | 6.2 | 3.9 | 4.9 | 4.3 | 4.7 | 3.9 | 9.1 | 5.7 | 24.5 | 5.1 | 10.7 | 4.1 |
| 23 | 6.0 | 6.1 | 4.8 | 4.3 | 6.2 | 3.7 | 13.4 | 4.7 | 13.5 | 4.8 | 7.8 | 4.1 |
| 24 | 5.9 | 9.4 | 5.3 | 4.2 | 6.8 | 3.6 | 11.5 | 9.2 | 7.4 | 4.5 | 6.8 | 4.1 |
| 25 | 5.4 | 11.0 | 5.4 | 4.2 | 6.1 | 3.4 | 6.9 | 10.2 | 6.6 | 6.8 | 6.4 | 4.1 |
| 26 | 4.9 | 12.0 | 5.2 | 6.0 | 5.6 | 3.3 | 5.7 | 6.4 | 5.9 | 13.3 | 6.1 | 4.1 |
| 27 | 4.6 | 14.0 | 5.1 | 8.2 | 4.9 | 3.4 | 5.3 | 5.4 | 5.6 | 16.0 | 5.9 | 4.1 |
| 28 | 4.6 | 12.5 | 5.0 | 10.4 | 4.7 | 3.4 | 5.0 | 4.9 | 5.2 | 14.8 | 5.7 | 4.2 |
| 29 | 4.5 | ....... | 5.1 | 12.2 | 4.5 | 3.5 | 4.7 | 4.5 | 5.0 | 8.5 | 5.5 | 5.3 |
| 30 | 4.3 | ....... | 9.2 | 10.3 | 6.0 | 3.6 | 5.1 | 4.4 | 4.8 | 7.2 | 5.2 | 5.0 |
| 31 | 4.2 | ....... | 11.1 | ....... | 5.2 | ....... | 4.9 | 4.0 | ....... | 6.8 | ....... | 5.6 |

*Station rating table for Meramec River near Eureka, Mo., from August 8, 1903, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.60 | 460 | 4.40 | 1,700 | 6.40 | 3,810 | 9.80 | 8,050 |
| 2.70 | 490 | 4.50 | 1,790 | 6.60 | 4,030 | 10.00 | 8,330 |
| 2.80 | 530 | 4.60 | 1,880 | 6.80 | 4,250 | 10.50 | 9,040 |
| 2.90 | 580 | 4.70 | 1,980 | 7.00 | 4,470 | 11.00 | 9,790 |
| 3.00 | 640 | 4.80 | 2,080 | 7.20 | 4,710 | 11.50 | 10,540 |
| 3.10 | 710 | 4.90 | 2,180 | 7.40 | 4,950 | 12.00 | 11,340 |
| 3.20 | 780 | 5.00 | 2,280 | 7.60 | 5,190 | 12.50 | 12,190 |
| 3.30 | 850 | 5.10 | 2,380 | 7.80 | 5,430 | 13.00 | 13,090 |
| 3.40 | 920 | 5.20 | 2,490 | 8.00 | 5,670 | 13.50 | 14,040 |
| 3.50 | 990 | 5.30 | 2,600 | 8.20 | 5,920 | 14.00 | 15,040 |
| 3.60 | 1,060 | 5.40 | 2,710 | 8.40 | 6,180 | 14.50 | 16,040 |
| 3.70 | 1,130 | 5.50 | 2,820 | 8.60 | 6,440 | 15.00 | 17,050 |
| 3.80 | 1,200 | 5.60 | 2,930 | 8.80 | 6,700 | 16.00 | 19,100 |
| 3.90 | 1,280 | 5.70 | 3,040 | 9.00 | 6,960 | 17.00 | 21,100 |
| 4.00 | 1,360 | 5.80 | 3,150 | 9.20 | 7,220 | 18.00 | 23,100 |
| 4.10 | 1,440 | 5.90 | 3,260 | 9.40 | 7,490 | 19.00 | 25,100 |
| 4.20 | 1,520 | 6.00 | 3,370 | 9.60 | 7,770 | 20.00 | 27,120 |
| 4.30 | 1,610 | 6.20 | 3,590 | | | | |

The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1903–1905. It is well defined between gage heights 2.8 feet and 6.2 feet. Two flood measurements at 11.6 and 25 feet gage heights, respectively, define the curve above this limit. Above gage height 20 feet the rating curve is a tangent, the difference being 210 per tenth. The left bank overflows at the approximate gage height of 22.2 feet. It has been estimated that the overflow at 36.2 feet gage height was 7,000 second-feet, or 50 second-feet, per tenth gage height.

*Estimated monthly discharge of Meramec River near Eureka, Mo., for 1905.*

[Drainage area, 3,497 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3,590 | 640 | 1,727 | 106,200 | 0.494 | 0.570 |
| February | 15,040 | 1,060 | 3,055 | 169,700 | .874 | .910 |
| March | 26,640 | 2,080 | 6,715 | 412,900 | 1.92 | 2.21 |
| April | 11,680 | 1,520 | 3,694 | 219,800 | 1.06 | 1.18 |
| May | 8,610 | 1,790 | 3,991 | 245,400 | 1.14 | 1.31 |
| June | 3,370 | 780 | 1,255 | 74,680 | .359 | .400 |
| July | 13,850 | 1,360 | 3,836 | 235,900 | 1.10 | 1.27 |
| August | 8,610 | 1,130 | 2,102 | 129,300 | .601 | .693 |
| September | 51,160 | 850 | 9,451 | 562,400 | 2.70 | 3.01 |
| October | 19,040 | 1,060 | 3,532 | 217,200 | 1.01 | 1.16 |
| November | 11,680 | 1,790 | 4,511 | 268,400 | 1.29 | 1.44 |
| December | 4,470 | 1,440 | 2,119 | 130,300 | .606 | .699 |
| The year | 51,160 | 640 | 3,832 | 2,772,000 | 1.10 | 14.85 |

## MERAMEC SPRING NEAR MERAMEC, MO.

This station was established February 28, 1903, by I. W. McConnell. It is located on Spring Branch, 500 feet from the spring, at a footbridge. This point is about 1 mile from the mouth of Spring Branch and 2 miles above the mouth of Dry Fork.

The channel is straight for 50 feet above and 500 feet below the station. Both banks are of clay and gravel and are about 6 feet high. They will overflow only at unusual flood stages. The bed of the stream is composed of gravel with some bowlders and is clean. The water is very swift, making accurate gage readings very difficult.

Discharge measurements are made from the footbridge. The initial point for soundings is at the tree at the end of the footbridge on the right bank. The bridge was washed out in 1904 and was rebuilt about 50 feet downstream from its old location.

The gage is a staff 10 feet long located near the bridge. During 1905 it was read by C. C. Smallwood. The bench mark is located on the left corner stone of the breast wheel of the tail race just below the old breast wheel, and is designated by a cross on the top surface of the stone; elevation, 4.75 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Descripton: 99, pp 235-236; 131, p 123.
Discharge: 99, p 236; 131, p 124.
Discharge, monthly: 99, p 237; 131, p 125.
Gage heights: 99, pp 236-237; 131, p 124.
Rating table: 99, p 237; 131, p 125.

*Discharge measurements of Meramec Spring near Meramec, Mo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 15 | S. K. Clapp | 55 | 75 | 6.50 | 1.70 | 488 |
| June 22 | M. S. Brennan | 27 | 41 | 2.30 | .37 | 95 |
| July 28 | do | 29 | 51 | 3.98 | .95 | 203 |
| September 8 | do | 27 | 42 | 2.24 | .40 | 94 |
| October 12 | do | 27 | 43 | 2.63 | .52 | 113 |
| December 20 | do | 27 | 41 | 2.51 | .40 | 103 |

*Daily gage height, in feet, of Meramec Spring near Meramec, Mo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.25 | 0.25 | 0.9 | 1.0 | 0.9 | 0.7 | 0.5 | 0.8 | 0.5 | 0.8 | 0.9 | 0.6 |
| 2 | .25 | .25 | .8 | .9 | .8 | .7 | .5 | .7 | .5 | .8 | .9 | .8 |
| 3 | .25 | .25 | .7 | .9 | .7 | .6 | .45 | .7 | .5 | .75 | .85 | .8 |
| 4 | .25 | .25 | .6 | .8 | .7 | .6 | .4 | .6 | .5 | .75 | .8 | .75 |
| 5 | .25 | .25 | .5 | .8 | .7 | .5 | .4 | .5 | .5 | .7 | 1.2 | .7 |
| 6 | .25 | .25 | .7 | .7 | .7 | .5 | .4 | .8 | .5 | .7 | 1.2 | .7 |
| 7 | .25 | .25 | 1.5 | .7 | .8 | .5 | .4 | .7 | .5 | .7 | 1.1 | .6 |
| 8 | .25 | .25 | 2.5 | .6 | .7 | .5 | .4 | .7 | .45 | .6 | 1.0 | .6 |
| 9 | .25 | .25 | 2.1 | .6 | .8 | .4 | .4 | .6 | .45 | .6 | .95 | .55 |
| 10 | .25 | .25 | 1.9 | .6 | .8 | .4 | .6 | .6 | .55 | .6 | .9 | .55 |
| 11 | .25 | .25 | 1.5 | .7 | .8 | .4 | 1.1 | .7 | .5 | .55 | .8 | .5 |
| 12 | .25 | .25 | 1.4 | .7 | .8 | .4 | 1.0 | .7 | .5 | .55 | .8 | .5 |
| 13 | .25 | .25 | 1.2 | .6 | .8 | .4 | .8 | .5 | .45 | .5 | .75 | .5 |
| 14 | .25 | .25 | 1.1 | .6 | 1.9 | .4 | .7 | .5 | .45 | .5 | .7 | .5 |
| 15 | .25 | .25 | 1.0 | .6 | 1.7 | .4 | .7 | .5 | .45 | .5 | .7 | .5 |
| 16 | .25 | .25 | .9 | .5 | 1.4 | .4 | .7 | .5 | .45 | .5 | .7 | .5 |
| 17 | .25 | .25 | .8 | .5 | 1.2 | .4 | .6 | .5 | 1.8 | .5 | .6 | .5 |
| 18 | .3 | .25 | .8 | .5 | 1.0 | .4 | .5 | .5 | 2.9 | .5 | .6 | .5 |
| 19 | .3 | .25 | .7 | .5 | .9 | .4 | .5 | .5 | 2.6 | .9 | 1.4 | .45 |
| 20 | .3 | .3 | .7 | .4 | .8 | .4 | .5 | .5 | 2.3 | .8 | 1.5 | .45 |
| 21 | .3 | .3 | .6 | .4 | .8 | .5 | 1.9 | .4 | 2.1 | .6 | 1.3 | .5 |
| 22 | .3 | .4 | .6 | .4 | 1.2 | .45 | 2.0 | .7 | 2.0 | .6 | 1.2 | .5 |
| 23 | .3 | .5 | .6 | .4 | 1.1 | .4 | 1.7 | 1.1 | 1.9 | .55 | 1.0 | .5 |
| 24 | .3 | .7 | .7 | .4 | 1.0 | .4 | 1.5 | .9 | 1.3 | .8 | .95 | .5 |
| 25 | .25 | .9 | .8 | .4 | 1.0 | .4 | 1.1 | .9 | 1.2 | 2.0 | .9 | .5 |
| 26 | .25 | 1.5 | .8 | 1.5 | .9 | .4 | 1.15 | .8 | 1.0 | 2.8 | .8 | .5 |
| 27 | .25 | 1.2 | .7 | 1.2 | .9 | .4 | .9 | .8 | .9 | 2.5 | .8 | .5 |
| 28 | .25 | 1.1 | .6 | 1.0 | .9 | .4 | 1.1 | .8 | .9 | 1.1 | .75 | .5 |
| 29 | .25 | ...... | .9 | 1.0 | .8 | .4 | 1.0 | .7 | .8 | .95 | .7 | .6 |
| 30 | .25 | ...... | 1.2 | 1.0 | .8 | .4 | .6 | .6 | .8 | .9 | .65 | .55 |
| 31 | .25 | ...... | 1.1 | ...... | .8 | ...... | .8 | .5 | ...... | .9 | ...... | ...... |

## COURTOIS CREEK AT SCOTIA, MO.

This station was established November 11, 1904. It is located at Scotia, a post-office 8 miles south of Leasburg, a small town on the St. Louis and San Francisco Railroad. The station may be reached by livery from Leasburg during low-water stages of Meramec River, and from Steelville by livery at all times.

The channel is straight for more than 200 feet above and below the station. The right bank is low, alluvial, and liable to overflow at ordinary high stages. The left bank is high and rocky and seldom overflows. The bed of the stream is clean below the overflow line and consists of coarse gravel. The current is direct and swift.

Discharge measurements are made by wading except at high stages, when a boat and tag line are used. A large tree at the wagon ford on the left bank is taken as the initial point for soundings.

The gage is a staff nailed to a leaning tree about 200 feet below the Scotia ford, on the left bank. The original gage and bench mark were destroyed, and a new gage and bench mark were put in at the same place April 9, 1905, but with the datum approximately 1.35 feet lower. All 1905 gage heights refer to the new datum. During 1905 the gage was read by Harry Lea. The bench mark is a spike driven into the tree at the gage; elevation, 6.69 feet above the datum of the new gage.

*Discharge measurements of Courtois Creek at Scotia, Mo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 9 | M. S. Brennan | 122 | 167 | 2.04 | 3.00 | 340 |
| May 16 | S. K. Clapp | 120 | 227 | 3.29 | 4.10 | 746 |
| June 23 | M. S. Brennan | 109 | 81 | 2.22 | 2.13 | 180 |
| July 27 | do | 115 | 138 | 3.05 | 3.15 | 426 |
| September 9 | do | 110 | 99 | 2.54 | 2.57 | 252 |
| October 13 | do | 111 | 85 | 2.34 | 2.35 | 199 |

*Daily gage height, in feet, of Courtois Creek at Scotia, Mo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.35 | 2.65 | 4.65 | ....... | 3.2 | 5.8 | 3.4 | 2.3 | 2.8 | 3.7 | 4.0 | 3.1 |
| 2 | 2.35 | 2.55 | 4.85 | ....... | 3.0 | 4.0 | 2.2 | 2.4 | 2.7 | 3.5 | 3.8 | 3.0 |
| 3 | 2.35 | 2.45 | 4.35 | ....... | 2.3 | 4.4 | 2.3 | 2.4 | 2.6 | 3.1 | 3.8 | 2.8 |
| 4 | 2.35 | 2.35 | 4.15 | ....... | 2.4 | 4.0 | 2.5 | 2.4 | 2.4 | 3.1 | 3.4 | 2.8 |
| 5 | 2.35 | 2.85 | 4.35 | ....... | 5.6 | 3.4 | 2.0 | 2.3 | 2.0 | 2.8 | 3.3 | 2.7 |
| 6 | 2.35 | 2.75 | 4.15 | ....... | 6.0 | 3.2 | 2.1 | 3.0 | 1.0 | 2.8 | 3.3 | 2.7 |
| 7 | 2.35 | 2.55 | ....... | ....... | 6.0 | 3.0 | 1.1 | 3.2 | 1.8 | 2.8 | 3.2 | 2.7 |
| 8 | 2.35 | 2.45 | ....... | ....... | 5.8 | 2.9 | 1.3 | 3.4 | 1.0 | 2.7 | 3.0 | 2.7 |
| 9 | 2.35 | 2.15 | 8.35 | ....... | 5.4 | 2.8 | 2.1 | 3.2 | 1.0 | 2.7 | 2.8 | 2.8 |
| 10 | 2.35 | 1.85 | 7.35 | 2.3 | 5.0 | 2.4 | 2.8 | 2.0 | 2.3 | 2.7 | 2.8 | 2.6 |
| 11 | 2.35 | 1.75 | 6.95 | 5.3 | 4.8 | 2.3 | 4.7 | 2.0 | 2.0 | 3.0 | 2.7 | 2.6 |
| 12 | 3.55 | 3.25 | 4.55 | 4.3 | 6.0 | 2.2 | 5.0 | 2.0 | 2.8 | 2.9 | 2.4 | 2.6 |
| 13 | 4.35 | 3.05 | 4.45 | 3.0 | 5.0 | 2.1 | 5.2 | 2.8 | 2.4 | 2.9 | 2.4 | 2.6 |
| 14 | 3.85 | 2.85 | 4.35 | 3.0 | 5.0 | 2.0 | 5.0 | 2.4 | 2.0 | 2.9 | 2.3 | 2.4 |
| 15 | 3.55 | 2.85 | 4.15 | 3.0 | 4.8 | 1.9 | 4.0 | 3.0 | 1.8 | 2.9 | 2.3 | 2.4 |
| 16 | 3.65 | 2.65 | 3.95 | 3.0 | 4.4 | 1.7 | ....... | 3.6 | 1.8 | 2.9 | 2.2 | 2.4 |
| 17 | 3.75 | 2.55 | 3.85 | 2.8 | 4.2 | 1.6 | ....... | 3.0 | 1.7 | 2.8 | 2.1 | 2.2 |
| 18 | 3.85 | 2.35 | 3.35 | 2.6 | 3.8 | 1.8 | ....... | 2.8 | 1.7 | 2.8 | 1.8 | 2.2 |
| 19 | 3.85 | 2.75 | 3.35 | 2.4 | 3.7 | 1.8 | ....... | 2.7 | 1.6 | 2.8 | 1.8 | 2.2 |
| 20 | 3.85 | 2.95 | 3.75 | 2.0 | 3.4 | 2.6 | ....... | 2.3 | ....... | 3.0 | 1.8 | 3.0 |
| 21 | 4.25 | 3.15 | 5.75 | 3.0 | 3.2 | 2.4 | ....... | 2.0 | ....... | 3.6 | 1.8 | 3.0 |
| 22 | 3.65 | 3.35 | 5.55 | 3.2 | 3.0 | 2.2 | ....... | 2.0 | ....... | 3.2 | 5.8 | 3.0 |
| 23 | 2.35 | 3.75 | 5.35 | 3.2 | 2.8 | 2.1 | 4.0 | ....... | 6.0 | 2.8 | 5.0 | 2.8 |
| 24 | 2.65 | 4.35 | ....... | 2.8 | 2.0 | 2.1 | 3.8 | ....... | 5.0 | 2.8 | 4.6 | 2.7 |
| 25 | 2.75 | 5.85 | ....... | 2.4 | 2.5 | 2.0 | 3.6 | 5.0 | 4.0 | 2.8 | 4.1 | 2.6 |
| 26 | 2.95 | 5.85 | ....... | 4.0 | 2.4 | 2.0 | 3.4 | 5.4 | 4.8 | 2.8 | 3.8 | 2.4 |
| 27 | 2.95 | 5.55 | ....... | 5.8 | 2.3 | 1.9 | 3.2 | 5.2 | 4.2 | 3.6 | 3.8 | 2.4 |
| 28 | 2.85 | 5.35 | ....... | 4.3 | 3.2 | 1.8 | 3.0 | 4.0 | 4.0 | ....... | 3.6 | 2.4 |
| 29 | 3.05 | ....... | ....... | 3.0 | 2.0 | 3.0 | 2.8 | 3.8 | 4.0 | ....... | 3.3 | 2.4 |
| 30 | 2.95 | ....... | ....... | 3.4 | ....... | 4.0 | 2.3 | 3.4 | 3.8 | 5.0 | 3.2 | 2.3 |
| 31 | 2.75 | ....... | ....... | ....... | 6.0 | ....... | 2.4 | 3.0 | ....... | 4.0 | ....... | 2.3 |

NOTE.—Water over gage March 7-8, May 30, August 23-24, September 20-22 October 28-29 Gage heights January 1 to March 31 may be somewhat in error, due to uncertainty of change in datum.

## ARKANSAS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The western rim of the Arkansas basin is formed by three of the highest mountain ranges of Colorado—the Saguache, Sangre de Cristo, and Culebra, each having summits reaching over 14,000 feet in altitude. The melting of the almost perpetual snow which mantles the high peaks near the north end of this rim furnishes water for three small creeks, known, respectively, as East, Lake, and Tennessee forks, and these, uniting near Leadville, form the Arkansas.

From the junction of the forks the river flows a little east of south for about 75 miles, then turns to the east and cuts through a canyon whose perpendicular walls attain elevations of over 2,000 feet above the water's edge, emerging finally into the plains region near Canyon. From Canyon to the Colorado-Kansas State line its general course is eastward for about 200 miles. Entering Kansas the river runs for 140 miles by general course a little south of east; it then makes a bold curve to the north, forming what is known as the Great Bend, below which it flows southeastward across Indian Territory to its junction with the Mississippi in northeastern Arkansas. The entire length of the stream from source to mouth, measured along the general course, is about 1,100 miles.

For about 120 miles from its source the river is a typical mountain torrent, descending in this distance from an elevation of 10,100 feet to about 5,300 feet. Its waters are clear and its bed is rocky. As it enters the plains region its gradient diminishes, its breadth increases it becomes unable at ordinary stages to carry the load of detritus collected in the more rapid portion above, and this detritus is gradually deposited, forming low, sandy banks and bars which block the course and cause the stream to shift its bed. At high stages this material is again caught up, the banks are eaten away, and very considerable changes of channel result from a single flood. The lower course of the river is bordered by wide alluvial bottoms, and the valley gradually merges with the valley of the Mississippi.

The drainage area as a whole is located a little south of the center of the United States, touching at its northernmost point latitude 39° 22′ N., and extending southward to latitude 33° 49′ N. Its eastern boundary is Mississippi River, its western the Rocky Mountains. The tract of country thus embraced comprises an area of approximately 188,000 square miles, and includes portions of Colorado, New Mexico, Kansas, Indian Territory, Texas, Missouri, and Arkansas. An area so immense necessarily presents great diversity in topography and resources. In the high mountains on the western border of the basin the passes range from 8,000 to 10,000 feet above sea, and some of the peaks tower to heights of over 14,000 feet. West of the one hundred and fifth meridian the country is generally mountainous and heavily timbered, and abounds in mineral wealth. Eastward stretch the seemingly endless rolling prairies of Colorado, Kansas, and Missouri. Throughout Indian Territory and Arkansas the country is more broken and includes a rough, mountainous section which extends across the northwest corner of Arkansas into southern Missouri. In the central part of Arkansas the surface is less rough and is largely a rolling prairie, with more or less timber interspersed. Toward the mouth of the river the country is low and heavily timbered and has a rich, black alluvial soil.

In its upper course the Arkansas is fed by numerous small streams, generally short, which lie wholly in or have their sources in the mountains. Those which head in the mountains and flow out onto the prairies are used more or less for irrigation. The most important of these tributaries are Greenhorn, Huerfano, Apishapa, and Purgatory rivers. East of the mountains the streams are all distinctively of the prairie type, and are bordered by bottom lands ranging from half a mile to 3 miles or more in width. In eastern Colorado and western Kansas the bottoms are light and sandy, but farther east they are alluvial in character. Rounded bluffs, 50 to 300 feet high, rise on both sides, and the country beyond is open and rolling. The stream beds are sandy—often quicksand—and muddy, there are no abrupt falls, and the streams run smoothly, with comparatively uniform descent. The plains tributaries include Black Squirrel, Horse, Two Butte, and Big Sandy creeks, Salt Fork, Cimarron, Verdigris, Grand, and Canadian rivers, and scores of smaller streams. The largest of these is Canadian River.

The principal source of the water which the river bears to the plains is the precipitation along the crest of the high ranges. This is mainly in the form of snow and amounts to 20 or 30 inches each year. From the foothills to Arkansas City the precipitation ranges from 12 to 35 inches, being 25 to 35 inches in the last 100 miles below Hutchinson. The natural storage in the basin is limited to a few mountain lakes of glacial origin.

The streams of this drainage area are subject to floods of two kinds—the annual spring floods caused by the melting of the snows in the headwater regions; and floods caused by the violent storms, locally known as cloudbursts, in the foothills and plains regions. Occasionally, too, the river runs dry, and many of the tributaries are intermittent in character.

## ARKANSAS RIVER NEAR CANYON, COLO.

The gaging station at Canyon, Colo., was established April 17, 1889, by Robert Robertson. It is located at the suspension footbridge at the Hot Springs Hotel, about 1 mile above the State penitentiary. This station is but a short distance below the mouth of Grape Creek, and at a point where the river leaves the mountains. Although there is an occasional break in the records, due to absence or changeof observer, they cover a period of seventeen years.

The station is of special importance, being located at the mouth of the canyon, at a point practically above the diversion of all water to the plains region, except the North and South Canyon ditches, both of which head above the station. During the irrigation season each of these ditches carries from 25 to 60 second-feet, according to the needs of the irrigators, and their discharge should be added to the discharge at the station in order to obtain the total run-off at the mouth of the canyon. No accurate records have been kept of the amount of water passing through these canals, although miscellaneous measurements have been made when measurements were made at the regular station. The estimated monthly discharges of Arkansas River at Canyon station do not include the water taken out by these canals.

The channel is straight for 500 feet above and 300 feet below the measuring section, and has a width of about 150 feet. The bed of the stream is rough, being composed of small bowlders, cobblestones, coarse gravel, and sand, and is not permanent from year to year, changing considerably with each high water. Both banks are high and rugged and are not liable to overflow. At times there are two channels, the main channel under the left bank, and a narrow channel discharging a few second-feet along the right bank. At high water there is but one channel. The gage heights range from 3 to 8 feet. The current is swift at all stages, exceptionally so at high water, and has a rough surface. Accurate measurements are difficult to obtain.

Discharge measurements were at first made from a cable and car, the bridge from which measurements were originally made by the State engineer having been destroyed. Later a new suspension bridge was constructed in front of the hotel, necessitating the removal and replacement of the gage, and subsequent measurements were made from this bridge. The initial point for soundings is marked on the floor of the bridge at the right bank, downstream side. A stay line is used for high-water measurements.

The gage established by Mr. Robertson in 1889 was an inclined staff attached to the crib of an old bridge, on the right bank of the river, almost directly in front of the hotel. Bench marks for this gage were as follows: (1) On the top of a log of the crib; elevation, 10.01 feet. (2) In the cleft of a red bowlder at the foot of a charred stump 50 feet downstream and on the same side of the river; elevation, 9.60 feet. (3) A bedded rock 40 feet from the north end of the cable, marked "B. M. No. 3, U. S. G. S.," 10 feet from the river bank; elevation 15.98 feet. Elevations refer to the datum of the gage.

A new gage was established October 4, 1895, on the opposite side of the stream, at the same datum. The channel had filled in about the Robertson gage and the top of the gage was broken off, making high-water readings impossible. December 27, 1895, the station was inspected, and it was found that readings had been made from the old rod, which at the stage of water prevailing recorded 0.40 foot above the new rod. When the water was high and extended with unbroken surface from bank to bank the readings were the same, but at low water the observations on the old rod were misleading, owing to the accumulation of sand and gravel in front of the gage.

August 26, 1902, because of the shifting of the channel, a new inclined gage rod was placed at the site of the previous rod, just below the north end of the suspension bridge. The datum of the gage was unchanged.

The present gage was established September 2, 1903, by the State engineer. It is located on the right bank just below the bridge, and consists of an inclined section reading from 0 to 7.3 feet, and a vertical section reading from 7.3 to 12 feet. The datum is the same as that of the preceding gage. During 1905 the gage was read twice each day by Dr. J. L. Prentiss. The bench mark is a cross cut in a bedded granite bowlder, 80 feet southeast of the south end of the suspension bridge, near the river bank; elevation, 16.07 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 11, ii, pp 47–48; 18, iv, p 225; Bull 131, pp 35–36; 140, p 156; WS 16, p 119; 28, p 107; 37, pp 258–259; 50, pp 323–324; 66, pp 48–49; 84, pp 133–134; 99, pp 297–298; 131, pp 126–128.

Discharge: Ann 14 ii, p 107; 18, iv, p 226; Bull 131, pp 90, 91, 92; 140, p 157; WS 16, p 119; 28, p 116; 37, p 259; 50, p 324; 66, p 49; 84, p 135; 99, p 299; 131, pp 128, 179.

Discharge, monthly: Ann 11, ii, pp 48, 97; 12, ii, pp 349, 360; 13, iii, p 94; 14, ii, pp 108–109; 18, iv, p 227; 19, iv, p 356; 20, iv, pp 329, 331–335; 21, iv, p 231; 22, iv, p 341; WS 75, p 145; 84, p 136; 99, p 301; 131, p 130.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 56.

Gage heights: Bull 131, pp 36–37; 140, p 157; WS 11, p 60; 16, p 119; 28, p 110; 37, p 259; 50, p 324; 66, p 49; 84, p 135; 99, p 299; 131, p 129.

Hydrographs: Ann 12, ii, p 242; 14, ii, p 107; 19, iv, p 357; 20, iv, p 336; 21, iv, p 231; 22, iv, p 341.

Rainfall and run-off relation: Ann 20, iv, p 330.

Rating tables: Ann 18, iv, p 226; 19, iv, p 355; Bull 131, p 36; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 135; 99, p 300; 131, p 129.

*Discharge measurements of Arkansas River near Canyon, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 17 | R. I. Meeker | 78 | 125 | 4.52 | 4.10 | 565 |
| May 11 | do | 88 | 153 | 5.31 | 4.40 | 812 |
| June 19 | do | 102 | 452 | 7.37 | 5.98 | 3,333 |
| June 20 | do | 102 | 438 | 7.32 | 5.85 | 3,204 |
| July 8 | do | 85 | 221 | 4.04 | 4.10 | 892 |
| August 15 | do | 90 | 165 | 3.09 | 3.60 | 510 |
| September 23[a] | do | 60 | 104 | 2.91 | 3.20 | 303 |

[a] Made at different section.

*Daily gage height, in feet, of Arkansas River near Canyon, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.8 | 3.75 | 3.8 | 3.8 | 4.65 | 5.6 | 5.0 | 4.25 | 3.5 | 3.0 | 3.35 | 3.4 |
| 2 | 3.8 | 3.7 | 3.8 | 3.8 | 4.9 | 6.05 | 4.85 | 4.4 | 3.4 | 3.05 | 3.4 | 3.45 |
| 3 | 3.75 | 3.8 | 3.8 | 3.8 | 4.75 | 6.65 | 4.65 | 4.35 | 3.35 | 3.3 | 3.4 | 3.5 |
| 4 | 3.7 | 3.8 | 3.85 | 3.7 | 4.5 | 7.1 | 4.5 | 4.25 | 3.4 | 3.35 | 3.45 | 3.4 |
| 5 | 3.7 | 3.8 | 3.9 | 3.75 | 4.5 | 7.4 | 4.35 | 4.2 | 3.35 | 3.35 | 3.65 | 3.4 |
| 6 | 3.7 | 3.8 | 4.05 | 3.8 | 4.4 | 7.0 | 4.2 | 4.1 | 3.3 | 3.25 | 3.7 | 3.4 |
| 7 | 3.7 | 3.8 | 4.35 | 4.05 | 4.4 | 7.05 | 4.2 | 4.05 | 3.3 | 3.1 | 3.7 | 3.4 |
| 8 | 3.7 | 3.7 | 4.2 | 4.1 | 4.4 | 7.25 | 4.15 | 4.0 | 3.3 | 3.1 | 3.6 | 3.4 |
| 9 | 3.7 | 3.7 | 3.85 | 4.15 | 4.5 | 7.5 | 4.15 | 3.85 | 3.3 | 3.1 | 3.55 | 3.3 |
| 10 | 3.6 | 3.65 | 3.75 | 4.4 | 4.5 | 7.65 | 4.25 | 3.8 | 3.3 | 3.0 | 3.4 | 3.3 |
| 11 | 3.6 | 3.55 | 3.7 | 4.0 | 4.4 | 7.25 | 4.25 | 3.75 | 3.3 | 3.0 | 3.4 | 3.3 |
| 12 | 3.5 | 3.4 | 3.7 | 4.0 | 4.4 | 7.05 | 4.25 | 3.75 | 3.3 | 3.0 | 3.3 | 3.3 |
| 13 | 3.45 | 3.55 | 3.7 | 4.1 | 4.35 | 7.0 | 4.25 | 3.75 | 3.2 | 3.05 | 3.25 | 3.3 |
| 14 | 3.5 | 3.7 | 3.7 | 4.15 | 4.3 | 6.9 | 4.25 | 3.7 | 3.2 | 3.1 | 3.2 | 3.3 |
| 15 | 3.65 | 3.65 | 3.75 | 4.1 | 4.25 | 7.0 | 4.25 | 3.75 | 3.2 | 3.2 | 3.3 | 3.3 |
| 16 | 3.85 | 3.75 | 4.05 | 4.1 | 4.35 | 6.65 | 4.25 | 3.92 | 3.2 | 3.25 | 3.3 | 3.35 |
| 17 | 3.85 | 3.95 | 4.1 | 4.0 | 4.45 | 6.4 | 4.2 | 3.9 | 3.2 | 3.3 | 3.3 | 3.4 |
| 18 | 3.8 | 3.95 | 4.0 | 3.9 | 4.65 | 6.15 | 3.95 | 3.85 | 3.2 | 3.3 | 3.3 | 3.3 |
| 19 | 3.8 | 3.9 | 4.0 | 4.0 | 4.75 | 5.95 | 4.05 | 3.8 | 3.2 | 3.3 | 3.3 | 3.3 |
| 20 | 3.8 | 3.9 | 4.0 | 4.0 | 4.95 | 5.8 | 4.15 | 3.75 | 3.2 | 3.3 | 3.3 | 3.25 |
| 21 | 3.8 | 3.9 | 3.9 | 4.0 | 5.1 | 5.6 | 4.3 | 3.75 | 3.2 | 3.3 | 3.3 | 3.2 |
| 22 | 3.8 | 3.9 | 3.8 | 3.9 | 5.25 | 5.8 | 4.3 | 3.8 | 3.2 | 3.25 | 3.3 | 3.2 |
| 23 | 3.8 | 3.9 | 3.75 | 4.1 | 5.45 | 5.6 | 4.25 | 3.8 | 3.15 | 3.3 | 3.3 | 3.2 |
| 24 | 3.8 | 3.9 | 3.75 | 4.35 | 5.5 | 5.4 | 4.25 | 3.95 | 3.1 | 3.3 | 3.3 | 3.2 |
| 25 | 3.85 | 3.85 | 3.8 | 4.45 | 5.5 | 5.5 | 4.15 | 3.85 | 3.1 | 3.3 | 3.3 | 3.2 |
| 26 | 3.8 | 3.8 | 3.8 | 4.5 | 5.5 | 5.45 | 4.15 | 3.8 | 3.0 | 3.3 | 3.35 | 3.2 |
| 27 | 3.8 | 3.8 | 3.8 | 4.45 | 5.5 | 5.35 | 4.0 | 3.75 | 3.0 | 3.3 | 3.4 | 3.1 |
| 28 | 3.8 | 3.8 | 3.8 | 4.7 | 5.5 | 5.25 | 5.85 | 4.5 | 3.0 | 3.3 | 3.45 | 3.05 |
| 29 | 3.8 | ....... | 3.7 | 4.6 | 5.4 | 5.15 | 4.55 | 3.55 | 3.0 | 3.3 | 3.3 | 3.0 |
| 30 | 3.8 | ....... | 3.7 | 4.8 | 5.3 | 5.1 | 4.1 | 3.5 | 3.0 | 3.3 | 3.35 | 3.0 |
| 31 | 3.85 | ....... | 3.7 | ....... | 5.3 | ....... | 4.25 | 3.45 | ....... | 3.3 | ....... | 3.0 |

*Station rating table for Arkansas River near Canyon, Colo., from January 1 to June 10, 1905*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet* | *Feet.* | *Second-feet* |
| 3.40 | 150 | 4.30 | 730 | 5.20 | 1,620 | 6.20 | 3,130 |
| 3.50 | 190 | 4.40 | 810 | 5.30 | 1,740 | 6.40 | 3,540 |
| 3.60 | 240 | 4.50 | 900 | 5.40 | 1,870 | 6.60 | 3,980 |
| 3.70 | 300 | 4.60 | 990 | 5.50 | 2,000 | 6.80 | 4,440 |
| 3.80 | 360 | 4.70 | 1,080 | 5.60 | 2,140 | 7.00 | 4,930 |
| 3.90 | 430 | 4.80 | 1,180 | 5.70 | 2,290 | 7.20 | 5,450 |
| 4.00 | 500 | 4.90 | 1,280 | 5.80 | 2,440 | 7.40 | 5,990 |
| 4.10 | 570 | 5.00 | 1,390 | 5.90 | 2,600 | 7.60 | 6,550 |
| 4.20 | 650 | 5.10 | 1,500 | 6.00 | 2,760 | | |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and two during the early part of 1905. It is fairly well defined between gage heights 3.5 feet and 4.8 feet. Above gage height 4.8 feet the rating curve is very uncertain, being drawn to meet, at the highest gage height, the curve for the period following high water. It can be considered only a rough approximation.

*Station rating table for Arkansas River near Canyon, Colo., from June 11 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.00 | 240 | 4.00 | 810 | 4.90 | 1,740 | 5.80 | 3,060 |
| 3.10 | 270 | 4.10 | 900 | 5.00 | 1,870 | 5.90 | 3,230 |
| 3.20 | 310 | 4.20 | 990 | 5.10 | 2,000 | 6.00 | 3,400 |
| 3.30 | 350 | 4.30 | 1,080 | 5.20 | 2,140 | 6.20 | 3,760 |
| 3.40 | 400 | 4.40 | 1,180 | 5.30 | 2,280 | 6.40 | 4,140 |
| 3.50 | 450 | 4.50 | 1,280 | 5.40 | 2,430 | 6.60 | 4,520 |
| 3.60 | 510 | 4.60 | 1,390 | 5.50 | 2,580 | 6.80 | 4,920 |
| 3.70 | 580 | 4.70 | 1,500 | 5.60 | 2,740 | 7.00 | 5,320 |
| 3.80 | 650 | 4.80 | 1,620 | 5.70 | 2,900 | 7.20 | 5,730 |
| 3.90 | 730 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during the latter part of 1905. It is fairly well defined between gage heights 3.2 feet and 4.2 feet. The table has been extended beyond these limits, being based on two measurements near 6 feet. Above 6 feet it is uncertain.

*Estimated monthly discharge of Arkansas River near Canyon, Colo., for 1905.*

[Drainage area, 3,060 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 395 | 170 | 324 | 19,920 | 0.106 | 0.122 |
| February | 465 | 150 | 349 | 19,380 | .114 | .119 |
| March | 770 | 300 | 404 | 24,840 | .132 | .152 |
| April | 1,180 | 300 | 599 | 35,640 | .196 | .219 |
| May | 2,000 | 690 | 1,254 | 77,110 | .410 | .473 |
| June | 6,690 | 2,000 | 3,977 | 236,700 | 1.30 | 1.45 |
| July | 1,870 | 690 | 1,064 | 65,420 | .348 | .401 |
| August | 1,280 | 425 | 743 | 45,680 | .243 | .280 |
| September | 450 | 240 | 319 | 18,980 | .104 | .116 |
| October | 375 | 240 | 318 | 19,550 | .104 | .120 |
| November | 580 | 310 | 395 | 23,500 | .129 | .144 |
| December | 450 | 240 | 343 | 21,090 | .112 | .129 |
| The year | 6,690 | 150 | 841 | 607,800 | .275 | 3.72 |

## ARKANSAS RIVER AT PUEBLO, COLO.

The gaging station at Pueblo, Colo., was established in September, 1894, by A. P. Davis, at the Santa Fe Avenue Bridge. Since that time continuous records have been kept up at various bridges for a period of eleven years. This station is an important one, being located near the head of the principal irrigated portion of Arkansas Valley and above the headgates of the larger canals. For this reason water superintendents and commissioners depend on gagings made at this station for data by which distribution of the water is made to canals below.

The Arkansas River channel at Pueblo is the best confined stream in Colorado. Above the Victoria Avenue Bridge slag levees and dry rubble walls confine the channel in a somewhat irregular course. From Victoria Avenue Bridge to Main Street Bridge, a distance of 600 feet, the channel is straight, of uniform width, and with perpendicular masonry walls. At the lower side of the Main Street Bridge the masonry walls give way to hand-laid slag levees, which, though straight, bear at a slight angle to the left of the masonry walls. The bed of the stream is composed of cobblestones, merging into coarse gravel and sand. There is but one channel at all stages. During extreme cold weather gage readings are discontinued, as the channel becomes obstructed with irregular masses and gorges of ice, which divide the stream into several channels. Gage heights range from 2 to 12 feet on the gage rod. During high water and its recession the channel is more or less shifting. During winter the channel fills in slightly and is scoured out again in the spring. The flow of the stream is rapid, but not too swift for accurate measurements.

Discharge measurements have been made principally from the Main Street Bridge, though some have been made at the Union Avenue Bridge. The Main Street Bridge consists of a single 151-foot span. A stay line is located 40 feet upstream and is used for measurements above gage height 4 feet. The initial point for soundings is the edge of the capstone of the right masonry retaining wall.

Originally there were two gage rods. The main gage was a vertical staff fastened to the left-bank abutment of the Denver and Rio Grande railroad bridge at Santa Fe avenue. There was also a short vertical rod for extreme low water fastened to a pile about 20 feet out in the stream. In June, 1895, an inclined staff gage was placed at the Victoria Avenue Bridge in order to determine the slope of the water surface. These rods were read until July 10, 1898, when, on account of the shifting of the bed of the river, they were abandoned, and a new gage was installed on the east side of the Main Street Bridge. Readings were made at the Main Street Bridge until March 3, 1900, when, owing to the scouring of the channel, a staff gage was fastened vertically to the masonry wall about 60 feet below the south end of the Union Avenue Bridge.

June 13, 1900, this rod was connected with a bench mark on the coping at the northwest corner of the Union Avenue Bridge, which was found to be 19.79 feet above the zero of the rod. In March, 1902, another rod was fastened vertically to the masonry wall on the right bank, about 30 feet above the south end of the Union Avenue Bridge. Gage heights from July 10, 1898, to July 14, 1902, were taken from the rod just below the Union Avenue Bridge. From July 14, 1902, until July 7, 1905, the readings were taken from the rod above the bridge. When the upper gage was set the datum was 0.2 foot higher than the lower gage. In all discharge measurements made in 1902 the gage height was taken from the rod above the Union Avenue Bridge.

In June, 1905, the gage above Union Avenue Bridge was rendered useless by shifting of the channel, and July 7, 1905, a standard chain gage was fastened to the upstream side of the Main Street Bridge, about 300 feet below the staff gage. The length of the chain is 19.32 feet. There are two markers, giving a range of 20 feet on a 10-foot scale. During 1905 the gage was read twice each day by David J. Cox. The bench mark is a cross painted on the footway at the gage-chain box; elevation, 18.60 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 11 ii, p 49; 18, iv, pp 227-228; Bull 140, p, 158; WS 16, p 120; 28, pp 107-108; 37, pp 259-260; 50, p 325; 66, pp 49-50; 84, pp 130-131; 99, pp 293-294; 131, pp 130-131.

Discharge: Ann 18, iv, p 228; Bull 131, p 90; 140, p 158; WS 16, p 120; 28, p 116; 37, p 260; 50, p 325; 66, p 50; 84, p 131; 99, p 295; 131, pp 132, 180.

Discharge, monthly: Ann 11, ii, pp 49, 98; 12, ii. p 360; 13, iii, p 94; 18, iv, p 230; 19, iv, p 357; 20, iv, pp 329, 336; 21, iv, p 232; 22, iv, p 342; WS 75, p 146; 84, p 133; 99, p 296; 131, p 133.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 56.

Gage heights: Bull 140, p 159; WS 11, p 61; 16, p 120; 28, p 111; 37, p 260; 50, p 326; 66, p 50; 84, p 132; 99, pp 295-296; 131, p 132.

Hydrographs: Ann 18, iv, p 231; 19, iv, p 357; 20, iv, p 337; 21, iv, p 232; 22, iv, p 342; WS 75, p 146.

Rainfall and run-off relation: Ann 20, iv, p 330.

Rating tables: Ann 18, iv, p 229; 19, iv, p 356; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 132; 99 p 296; 131, p 133.

*Discharge measurements of Arkansas River at Pueblo, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 4 | R. I. Meeker | 107 | 111 | 3.51 | 2.25 | 390 |
| March 11 | do | 75 | 87 | 3.71 | 2.10 | 323 |
| March 16 | do | 99 | 133 | 4.10 | 2.50 | 556 |
| May 10 | do | 151 | 274 | 4.93 | 3.40 | 1,352 |
| June 6 | M. P. Beeson | 150 | 835 | 8.15 | 6.75 | 6,804 |
| June 7 | R. I. Meeker | 150 | 640 | 8.20 | 5.85 | 5,251 |
| Do | do | 150 | 655 | 8.03 | 5.90 | 5,257 |
| June 20 | do | 150 | 410 | 6.80 | 4.25 | 2,765 |
| June 24 | do | 150 | 396 | 6.70 | 4.15 | 2,655 |
| July 7 | do | 149 | 196 | 4.06 | 2.72 | 796 |
| August 9 | do | 151 | 230 | 4.35 | 3.02 | 1,000 |
| September 23 | do | 80 | 102 | 2.65 | 2.15 | 270 |
| November 4 | do | 89 | 119 | 2.97 | 2.30 | 353 |

*Daily gage height, in feet, of Arkansas River at Pueblo, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.1 | 1.95 | 2.4 | 4.05 | 4.05 | 4.3 | 3.35 | 3.3 | 2.4 | 2.05 | 2.35 | 2.55 |
| 2 | 2.1 | 1.95 | 2.4 | 2.9 | 3.9 | 4.75 | 3.15 | 3.35 | 2.4 | 2.08 | 2.33 | 2.55 |
| 3 | 2.05 | 1.95 | 2.4 | 2.8 | 3.75 | 5.1 | 3.0 | 3.05 | 2.35 | 2.05 | 2.33 | 2.52 |
| 4 | 2.05 | 1.95 | 2.3 | 2.6 | 3.6 | 6.3 | 2.95 | 2.95 | 2.4 | 2.38 | 2.35 | 2.45 |
| 5 | 2.0 | 1.95 | 2.3 | 2.55 | 3.5 | 6.55 | 2.85 | 2.85 | 2.35 | 2.32 | 2.42 | 2.45 |
| 6 | 2.0 | 2.0 | 2.3 | 2.55 | 3.45 | 6.6 | 2.75 | 2.85 | 2.55 | 2.3 | 2.6 | 2.48 |
| 7 | 2.0 | 2.0 | 2.7 | 2.8 | 3.35 | 6.05 | 2.55 | 3.25 | 2.7 | 2.2 | 2.62 | 2.48 |
| 8 | 2.0 | 2.0 | 2.75 | 2.9 | 3.35 | 6.25 | 2.65 | 3.15 | 2.55 | 2.12 | 2.58 | 2.48 |
| 9 | 2.0 | 2.0 | 2.65 | 2.85 | 3.55 | 6.55 | 2.8 | 2.95 | 2.4 | 2.05 | 2.5 | 2.5 |
| 10 | 1.95 | 2.0 | 2.45 | 2.9 | 3.45 | 6.6 | 2.75 | 2.95 | 2.35 | 1.95 | 2.38 | 2.5 |
| 11 | 1.95 | 2.0 | 2.2 | 2.75 | 3.35 | 6.0 | 3.0 | 2.85 | 2.45 | 1.97 | 2.4 | 2.5 |
| 12 | 1.95 | 2.0 | 2.1 | 2.75 | 3.3 | 5.7 | 3.0 | 3.0 | 2.3 | 2.03 | 2.35 | 2.48 |
| 13 | 1.9 | 2.0 | 2.1 | 2.75 | 3.25 | 5.7 | 2.85 | 2.75 | 2.25 | 1.97 | 2.3 | 2.52 |
| 14 | 1.9 | 2.0 | 2.2 | 2.75 | 3.25 | 5.6 | 2.85 | 2.55 | 2.3 | 2.0 | 2.25 | 2.52 |
| 15 | 1.9 | 2.0 | 2.35 | 2.75 | 3.2 | 5.45 | 2.8 | 2.55 | 2.3 | 2.0 | 2.28 | 2.52 |
| 16 | 1.9 | 2.0 | 2.4 | 2.7 | 3.2 | 5.25 | 2.9 | 2.85 | 2.25 | 2.07 | 2.28 | 2.52 |
| 17 | 1.9 | 2.0 | 2.6 | 2.75 | 3.2 | 5.15 | 2.85 | 2.9 | 2.2 | 2.05 | 2.3 | 2.52 |
| 18 | 1.9 | 2.0 | 2.6 | 2.6 | 3.45 | 4.8 | 2.7 | 2.85 | 2.2 | 2.2 | 2.28 | 2.52 |
| 19 | 1.9 | 2.0 | 2.5 | 2.65 | 3.55 | 4.65 | 2.5 | 2.75 | 2.2 | 2.23 | 2.28 | 2.5 |
| 20 | 1.9 | 2.05 | 2.5 | 2.65 | 4.1 | 4.2 | 2.7 | 3.1 | 2.2 | 2.17 | 2.22 | 2.5 |
| 21 | 1.9 | 2.1 | 2.4 | 2.55 | 4.2 | 4.0 | 3.0 | 2.75 | 2.2 | 2.2 | 2.22 | 2.48 |
| 22 | 1.9 | 2.15 | 2.4 | 2.45 | 4.35 | 3.85 | 3.2 | 2.55 | 2.2 | 2.2 | 2.2 | 2.42 |
| 23 | 1.9 | 2.2 | 2.3 | 2.7 | 4.45 | 3.9 | 3.0 | 2.35 | 2.15 | 2.27 | 2.25 | 2.38 |
| 24 | 1.9 | 2.25 | 2.3 | 3.4 | 4.6 | 3.85 | 2.8 | 2.55 | 2.15 | 2.25 | 2.3 | 2.4 |
| 25 | 1.9 | 2.3 | 2.25 | 3.5 | 4.6 | 3.8 | 2.75 | 2.7 | 2.12 | 2.25 | 2.25 | 2.4 |
| 26 | 1.9 | 2.35 | 2.25 | 3.95 | 4.45 | 3.7 | 2.8 | 2.65 | 2.1 | 2.23 | 2.22 | 2.42 |
| 27 | 1.9 | 2.4 | 2.35 | 3.75 | 4.45 | 3.7 | 3.05 | 2.65 | 2.08 | 2.2 | 2.3 | 2.4 |
| 28 | 1.9 | 2.4 | 2.4 | 3.75 | 4.4 | 3.65 | 2.65 | 2.4 | 2.05 | 2.2 | 2.3 | 2.4 |
| 29 | 1.9 | | 2.35 | 3.8 | 4.35 | 3.7 | 2.45 | 2.35 | 2.05 | 2.25 | 2.4 | 2.35 |
| 30 | 1.9 | | 2.3 | 3.85 | 4.15 | 3.45 | 3.05 | 2.5 | 2.05 | 2.27 | 2.48 | 2.3 |
| 31 | 1.9 | | 2.3 | | 4.1 | | 3.0 | 2.45 | | 2.3 | | 2.22 |

NOTE.—Gage heights during January and February have been reduced on account of ice conditions.

*Station rating table for Arkansas River at Pueblo, Colo., from January 1 to June 10, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 255 | 3.10 | 1,130 | 4.20 | 2,650 | 5.30 | 4,330 |
| 2.10 | 300 | 3.20 | 1,250 | 4.30 | 2,800 | 5.40 | 4,490 |
| 2.20 | 350 | 3.30 | 1,370 | 4.40 | 2,950 | 5.50 | 4,650 |
| 2.30 | 410 | 3.40 | 1,500 | 4.50 | 3,100 | 5.60 | 4,810 |
| 2.40 | 480 | 3.50 | 1,630 | 4.60 | 3,250 | 5.70 | 4,975 |
| 2.50 | 560 | 3.60 | 1,770 | 4.70 | 3,400 | 5.80 | 5,140 |
| 2.60 | 640 | 3.70 | 1,910 | 4.80 | 3,550 | 5.90 | 5,305 |
| 2.70 | 730 | 3.80 | 2,050 | 4.90 | 3,705 | 6.00 | 5,470 |
| 2.80 | 820 | 3.90 | 2,200 | 5.00 | 3,860 | 6.20 | 5,800 |
| 2.90 | 920 | 4.00 | 2,350 | 5.10 | 4,015 | 6.40 | 6,130 |
| 3.00 | 1,020 | 4.10 | 2,500 | 5.20 | 4,170 | 6.60 | 6,460 |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904 and seven measurements during the first part of 1905. It is fairly well defined.

*Station rating table for Arkansas River at Pueblo, Colo., from June 11 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 200 | 2.40 | 420 | 2.80 | 770 | 3.20 | 1,230 |
| 2.10 | 240 | 2.50 | 500 | 2.90 | 870 | 3.30 | 1,360 |
| 2.20 | 290 | 2.60 | 580 | 3.00 | 980 | 3.40 | 1,490 |
| 2.30 | 350 | 2.70 | 670 | 3.10 | 1,100 | 3.50 | 1,630 |

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. It is well defined.

Above 3.5 feet the table is the same as the preceding one. Changes in conditions due to flood make two tables necessary for 1905.

*Estimated monthly discharge of Arkansas River at Pueblo, Colo., for 1905.*

[Drainage area, 4,600 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 300 | 215 | 233 | 14,330 | 0.051 | 0.059 |
| February | 480 | 235 | 293 | 16,270 | .064 | .067 |
| March | 775 | 300 | 475 | 29,210 | .103 | .119 |
| April | 2,425 | 520 | 1,077 | 64,080 | .234 | .261 |
| May | 3,250 | 1,250 | 2,085 | 128,200 | .453 | .522 |
| June | 6,460 | 1,560 | 3,867 | 230,100 | .841 | .938 |
| July | 1,425 | 460 | 845 | 51,960 | .184 | .212 |
| August | 1,425 | 385 | 790 | 48,580 | .172 | .198 |
| September | 670 | 220 | 346 | 20,590 | .075 | .084 |
| October | 406 | 180 | 274 | 16,850 | .060 | .069 |
| November | 598 | 290 | 385 | 22,910 | .084 | .094 |
| December | 540 | 302 | 469 | 28,840 | .102 | .118 |
| The year | 6,460 | 180 | 928 | 671,900 | .202 | 2.74 |

## ARKANSAS RIVER NEAR SYRACUSE, KANS.

This station, established August 21, 1902, by W. G. Russell, is located on the highway bridge 1 mile south of Syracuse, Kans.

The channel above and below the station is straight and the water is sluggish. The right bank is low and liable to overflow; the left bank is high, and the bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the downstream pile of a bent, 158 feet from the initial point for soundings. During 1905 the gage was read once each day by Philip Botts. The bench mark is on the top of the east end of the first sill at the north end of the bridge. Elevation, 11.52 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 84, p 123; 99, p 269; 131, p 134.
**Discharge**: 84, p 123; 99, p 269; 131, p 134.
**Discharge, monthly**: 84, p 125; 99, p 271.
**Gage heights**: 84, p 124; 99, p 270; 131, p 135.
**Rating tables**: 84, p 124; 99, pp 270-271.

*Discharge measurements of Arkansas River, near Syracuse, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 19 | W. G. Russell | 262 | 328 | 2.39 | 2.70 | 785 |
| June 7 | .....do | 420 | 1,341 | 3.85 | 4.75 | 5,162 |
| June 8 | .....do | 532 | 1,656 | 3.84 | 5.15 | 6,362 |
| June 8 | .....do | 562 | 1,833 | 3.77 | 5.40 | 6,909 |
| June 9 | .....do | 527 | 1,595 | 3.57 | 5.20 | 5,701 |
| July 30 | .....do | 380 | 966 | 2.55 | 4.00 | 2,468 |
| August 19 | .....do | 208 | 140 | 1.51 | 2.30 | 211 |

*Daily gage height, in feet, of Arkansas River near Syracuse, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 1.9 | 2.5 | 2.0 | 5.0 | 4.3 | 2.8 | 3.5 | 2.4 | 1.9 | 2.0 |
| 2 | 1.5 | 1.9 | 2.5 | 3.0 | 4.9 | 4.3 | 2.7 | 6.3 | 2.2 | 1.9 | 2.0 |
| 3 | 1.4 | 2.0 | 2.3 | 5.25 | 4.8 | 4.6 | 2.6 | 6.1 | 2.3 | 1.9 | 2.0 |
| 4 | 1.7 | 2.5 | 2.3 | 5.0 | 4.7 | 4.0 | 2.5 | 4.7 | 2.0 | 1.9 | 2.0 |
| 5 | 1.7 | 2.5 | 2.1 | 4.0 | 4.6 | 4.0 | 2.8 | 4.2 | 2.4 | 1.8 | 2.1 |
| 6 | 1.8 | 2.5 | 2.1 | 3.5 | 4.5 | 4.3 | 2.8 | 3.7 | 2.4 | 1.8 | 2.1 |
| 7 | 2.0 | 2.5 | 2.0 | 3.5 | 4.4 | 4.7 | 2.7 | 3.2 | 2.3 | 1.8 | 2.1 |
| 8 | 2.0 | 2.5 | 2.0 | 3.1 | 4.3 | 5.4 | 2.6 | 3.7 | 2.3 | 1.8 | 2.0 |
| 9 | 2.0 | 2.5 | 1.8 | 2.9 | 4.0 | 5.2 | 2.5 | 3.5 | 3.4 | 1.8 | 1.9 |
| 10 | 1.8 | 2.5 | 1.8 | 3.1 | 3.9 | 5.4 | 2.4 | 3.2 | 3.2 | 1.7 | 1.9 |
| 11 | 1.8 | 2.5 | 1.8 | 3.1 | 3.8 | 5.1 | 2.4 | 3.1 | 3.0 | 1.8 | 1.9 |
| 12 | 1.7 | 2.5 | 1.8 | 3.1 | 4.4 | 5.1 | 2.0 | 3.1 | 2.7 | 1.8 | 2.0 |
| 13 | 1.7 | 2.8 | 1.8 | 3.2 | 4.6 | 5.0 | 1.9 | 2.8 | 2.6 | 1.8 | 2.0 |
| 14 | 1.5 | 2.8 | 1.8 | 3.4 | 4.4 | 5.0 | 1.8 | 2.7 | 2.6 | 1.8 | 2.0 |
| 15 | 1.5 | 2.8 | 1.8 | 3.1 | 4.2 | 4.7 | 2.2 | 2.7 | 2.6 | 1.8 | 2.0 |
| 16 | 1.7 | 2.8 | 1.8 | 3.1 | 4.2 | 4.7 | 1.9 | 2.6 | 2.4 | 1.8 | 2.1 |
| 17 | 1.8 | 2.8 | 1.9 | 2.8 | 4.2 | 4.7 | 1.8 | 2.6 | 2.3 | 1.8 | 2.0 |
| 18 | 1.9 | 2.8 | 1.9 | 2.8 | 4.2 | 4.5 | 1.8 | 2.6 | 2.4 | 1.8 | 2.0 |
| 19 | 2.0 | 3.0 | 1.8 | 2.7 | 4.2 | 4.5 | 1.8 | 2.5 | 2.4 | 1.8 | 2.0 |
| 20 | 2.4 | 3.0 | 1.8 | 2.7 | 4.8 | 4.3 | 1.8 | 2.2 | 2.4 | 1.8 | 2.0 |
| 21 | 2.4 | 3.3 | 2.5 | 2.7 | 4.8 | 4.0 | 1.8 | 2.0 | 2.3 | 1.8 | 2.0 |
| 22 | 2.0 | 3.4 | 2.4 | 2.6 | 4.5 | 4.5 | 1.8 | 2.1 | 2.3 | 1.8 | 2.0 |
| 23 | 2.0 | 3.5 | 2.2 | 2.6 | 4.4 | 4.3 | 1.8 | 2.2 | 2.3 | 1.8 | 2.0 |
| 24 | 1.8 | 3.5 | 2.0 | 3.5 | 4.2 | 3.7 | 2.3 | 2.0 | 2.0 | 1.8 | 2.1 |
| 25 | 1.8 | 3.3 | 2.0 | 7.25 | 6.5 | 3.5 | 2.4 | 1.9 | 2.0 | 1.8 | 2.1 |
| 26 | 1.5 | 3.0 | 1.8 | 6.5 | 4.7 | 3.5 | 2.5 | 1.8 | 2.1 | 1.8 | 2.1 |
| 27 | 1.5 | 3.0 | 1.8 | 5.05 | 5.0 | 3.4 | 2.7 | 1.8 | 2.0 | 1.8 | 2.1 |
| 28 | 1.5 | 2.8 | 1.9 | 6.25 | 5.0 | 3.3 | 2.5 | 3.3 | 2.0 | 1.8 | 2.2 |
| 29 | 1.7 | ....... | 1.8 | 5.0 | 4.8 | 3.0 | 4.8 | 2.9 | 2.0 | 1.8 | 2.2 |
| 30 | 1.7 | ....... | 1.7 | 5.0 | 4.7 | 2.9 | 4.3 | 2.6 | 1.9 | 1.8 | 2.3 |
| 31 | 1.8 | ....... | 1.7 | ....... | 4.5 | ....... | 3.4 | 2.5 | ....... | 2.0 | ....... |

*Station rating table for Arkansas River near Syracuse, Kans., from January 1 to November 30, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 3 | 2.60 | 535 | 3.80 | 2,100 | 5.00 | 5,800 |
| 1.40 | 5 | 2.70 | 625 | 3.90 | 2,300 | 5.20 | 6,750 |
| 1.50 | 10 | 2.80 | 725 | 4.00 | 2,500 | 5.40 | 7,900 |
| 1.60 | 20 | 2.90 | 835 | 4.10 | 2,720 | 5.60 | 9,100 |
| 1.70 | 40 | 3.00 | 950 | 4.20 | 2,950 | 5.80 | 10,500 |
| 1.80 | 65 | 3.10 | 1,070 | 4.30 | 3,200 | 6.00 | 12,000 |
| 1.90 | 95 | 3.20 | 1,200 | 4.40 | 3,500 | 6.20 | 13,600 |
| 2.00 | 130 | 3.30 | 1,335 | 4.50 | 3,800 | 6.40 | 15,400 |
| 2.10 | 175 | 3.40 | 1,480 | 4.60 | 4,150 | 6.60 | 17,200 |
| 2.20 | 230 | 3.50 | 1,625 | 4.70 | 4,500 | 6.80 | 19,300 |
| 2.30 | 295 | 3.60 | 1,775 | 4.80 | 4,900 | 7.00 | 21,500 |
| 2.40 | 370 | 3.70 | 1,930 | 4.90 | 5,350 | 7.20 | 24,100 |
| 2.50 | 450 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905 and three high-water measurements of 1903. It is not very well defined.

*Estimated monthly discharge of Arkansas River near Syracuse, Kans., for 1905.*

[Drainage area, 24,960 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 370 | 3 | 78.0 | 4,796 | 0.0031 | 0.0036 |
| February | 1,625 | 95 | 737 | 40,930 | .030 | .031 |
| March | 450 | 40 | 149 | 9,162 | .0060 | .0069 |
| April | 24,800 | 130 | 3,613 | 215,000 | .145 | .162 |
| May | 16,300 | 2,100 | 4,311 | 265,100 | .173 | .199 |
| June | 7,900 | 835 | 3,783 | 225,100 | .152 | .170 |
| July | 4,900 | 65 | 612 | 37,630 | .025 | .029 |
| August | 14,500 | 65 | 1,765 | 108,500 | .071 | .082 |
| September | 1,480 | 95 | 393 | 23,380 | .016 | .018 |
| October | 130 | 40 | 70.2 | 4,316 | .0028 | .0032 |
| November | 295 | 95 | 151 | 8,985 | .0060 | .0067 |
| The period | | | | 942,900 | | |

## ARKANSAS RIVER NEAR DODGE, KANS.

This station was established November 28, 1902, by W. G. Russell, and is located one-fourth mile south of Dodge, on the highway bridge.

The channel both above and below the station is straight for about 100 feet. Both banks are low and liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the upstream pile of a bent 337 feet from the north end of the bridge. During 1905 the gage was read once each day by Alexander Alter. Bench marks were established as follows: (1) The top of the east end of the cap at the north end of the bridge; elevation 9.83 feet. (2) The top of the east end of the cap at the abutment of the south end of the bridge; elevation, 10.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 123; 99, p 268; 131, p 135.
Discharge: 84, p 123; 99, p 268; 131, p 136.
Discharge, monthly: 131, p 138.
Gage heights: 84, p 128; 99, pp 268-269; 131, p 137.
Rating table: 131, p 138.

*Discharge measurements of Arkansas River near Dodge, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | W. G. Russell | 455 | 435 | 1.98 | 2.10 | 865 |
| June 10 | do | 482 | 1,616 | 3.42 | 3.90 | 5,519 |
| June 11 | do | 485 | 1,624 | 3.79 | 4.10 | 6,150 |
| June 11 | do | 487 | 1,757 | 4.14 | 4.40 | 7,273 |
| July 31 | do | 467 | 570 | 2.59 | 2.70 | 1,476 |
| August 18 | do | 264 | 100 | 1.31 | 1.70 | 131 |
| September 24 | do | 34 | 5.4 | .83 | 1.10 | 4.5 |

*Daily gage height, in feet, of Arkansas River near Dodge, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 2.05 | 2.4 | 1.4 | 4.8 | 3.55 | 2.0 | 2.4 | 1.1 | 1.0 |
| 2 | 1.4 | 2.1 | 2.3 | 1.4 | 4.25 | 3.35 | 1.9 | 2.25 | 1.1 | 1.0 |
| 3 | 1.4 | 2.1 | 2.2 | 1.4 | 4.0 | 3.0 | 1.9 | 2.85 | 1.1 | 1.0 |
| 4 | 1.4 | 2.1 | 2.05 | 2.8 | 4.0 | 3.0 | 1.75 | 3.55 | 1.1 | 1.0 |
| 5 | 1.4 | 2.1 | 2.0 | 3.5 | 4.0 | 3.0 | 1.6 | 3.1 | 1.1 | 1.0 |
| 6 | 1.4 | 2.1 | 1.9 | 3.2 | 4.1 | 2.6 | 1.5 | 2.95 | 1.1 | 1.0 |
| 7 | 1.4 | 2.1 | 1.85 | 2.8 | 4.0 | 2.65 | 1.45 | 2.7 | 1.1 | 1.0 |
| 8 | 1.55 | 2.1 | 1.8 | 2.6 | 3.6 | 2.55 | 1.5 | 2.6 | 1.35 | .9 |
| 9 | 1.75 | 2.1 | 1.8 | 2.5 | 3.55 | 3.85 | 1.4 | 1.95 | 1.5 | .9 |
| 10 | 1.8 | 2.1 | 1.7 | 2.5 | 3.3 | 4.0 | 1.4 | 1.85 | 1.5 | .9 |
| 11 | 1.8 | 2.1 | 1.7 | 2.4 | 3.0 | 4.0 | 1.4 | 1.8 | 1.5 | .9 |
| 12 | 1.8 | .9 | 1.7 | 2.3 | 2.6 | 4.0 | 1.35 | 1.7 | 1.45 | .9 |
| 13 | 1.8 | .9 | 1.7 | 2.3 | 3.65 | 4.0 | 1.3 | 2.05 | 1.4 | .9 |
| 14 | 1.8 | .9 | 1.6 | 2.3 | 3.65 | 4.0 | 1.2 | 1.95 | 1.5 | .9 |
| 15 | 1.7 | .9 | 1.6 | 2.5 | 3.55 | 4.0 | 1.2 | 1.85 | 1.45 | 1.0 |
| 16 | 1.7 | .9 | 1.6 | 2.5 | 3.5 | 3.95 | 1.1 | 1.7 | 1.4 | 1.0 |
| 17 | 1.7 | .9 | 1.6 | 2.35 | 3.65 | 3.6 | 1.1 | 1.7 | 1.1 | 1.1 |
| 18 | 1.7 | .9 | 1.6 | 2.15 | 3.7 | 3.5 | 1.1 | 1.35 | 1.1 | 1.2 |
| 19 | 1.7 | .9 | 1.6 | 2.15 | 3.5 | 3.35 | 1.05 | 1.3 | 1.1 | 1.2 |
| 20 | 1.8 | .9 | 1.6 | 2.2 | 3.5 | 3.6 | 1.0 | 1.4 | 1.1 | 1.3 |
| 21 | 1.8 | .9 | 1.6 | 2.2 | 4.5 | 3.4 | 1.0 | 1.3 | 1.1 | 1.3 |
| 22 | 1.85 | .9 | 1.5 | 2.2 | 4.65 | 3.2 | 1.1 | 1.2 | 1.1 | 1.3 |
| 23 | 1.95 | 1.0 | 1.4 | 2.3 | 4.35 | 3.2 | 1.1 | 1.2 | 1.1 | 1.3 |
| 24 | 1.9 | 2.5 | 1.5 | 2.6 | 4.0 | 3.2 | 1.1 | 1.2 | 1.05 | 1.3 |
| 25 | 1.9 | 2.6 | 1.5 | 3.0 | 4.75 | 2.9 | 1.1 | 1.1 | 1.0 | 1.3 |
| 26 | 1.9 | 2.6 | 1.5 | 6.25 | 4.25 | 2.5 | 1.1 | 1.1 | 1.0 | 1.3 |
| 27 | 2.0 | 2.8 | 1.5 | 5.25 | 3.5 | 2.4 | 1.0 | 1.1 | 1.0 | 1.3 |
| 28 | 2.0 | 2.55 | 1.4 | 4.75 | 4.25 | 2.35 | 1.0 | 1.1 | 1.0 | 1.3 |
| 29 | 2.0 | ........ | 1.4 | 5.45 | 5.9 | 2.15 | 1.0 | 1.0 | 1.0 | 1.3 |
| 30 | 2.0 | ........ | 1.3 | 4.75 | 4.25 | 2.0 | 1.3 | 1.0 | 1.0 | 1.3 |
| 31 | 2.0 | ........ | 1.3 | ........ | 4.0 | ........ | 2.5 | 1.0 | ........ | 1.4 |

NOTE.—River frozen January 1 to February 23, approximately.

*Station rating table for Arkansas River near Dodge, Kans., from January 1 to June 12, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 180 | 2.40 | 1,335 | 3.50 | 4,100 | 4.60 | 8,110 |
| 1.40 | 225 | 2.50 | 1,530 | 3.60 | 4,425 | 4.70 | 8,550 |
| 1.50 | 280 | 2.60 | 1,735 | 3.70 | 4,760 | 4.80 | 9,000 |
| 1.60 | 345 | 2.70 | 1,950 | 3.80 | 5,100 | 4.90 | 9,465 |
| 1.70 | 420 | 2.80 | 2,175 | 3.90 | 5,450 | 5.00 | 9,950 |
| 1.80 | 505 | 2.90 | 2,410 | 4.00 | 5,800 | 5.20 | 10,930 |
| 1.90 | 605 | 3.00 | 2,660 | 4.10 | 6,160 | 5.40 | 11,910 |
| 2.00 | 720 | 3.10 | 2,920 | 4.20 | 6,530 | 5.60 | 12,900 |
| 2.10 | 850 | 3.20 | 3,195 | 4.30 | 6,910 | 5.80 | 13,920 |
| 2.20 | 995 | 3.30 | 3,485 | 4.40 | 7,300 | 6.00 | 14,950 |
| 2.30 | 1,155 | 3.40 | 3,785 | 4.50 | 7,700 | | |

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during April to June, 1905. Owing to the shifting character of the stream bed and insufficient measurements, the above table is very uncertain.

*Station rating table for Arkansas River near Dodge, Kans., from June 13 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 2 | 1.80 | 200 | 2.60 | 1,255 | 3.40 | 3,425 |
| 1.10 | 4.5 | 1.90 | 275 | 2.70 | 1,460 | 3.50 | 3,770 |
| 1.20 | 10 | 2.00 | 370 | 2.80 | 1,685 | 3.60 | 4,125 |
| 1.30 | 20 | 2.10 | 480 | 2.90 | 1,930 | 3.70 | 4,490 |
| 1.40 | 35 | 2.20 | 605 | 3.00 | 2,195 | 3.80 | 4,860 |
| 1.50 | 60 | 2.30 | 745 | 3.10 | 2,480 | 3.90 | 5,235 |
| 1.60 | 95 | 2.40 | 900 | 3.20 | 2,780 | 4.00 | 5,620 |
| 1.70 | 140 | 2.50 | 1,070 | 3.30 | 3,095 | | |

The above table is based on three discharge measurements made during July and August, 1905. See note to table above.

*Estimated monthly discharge of Arkansas River near Dodge, Kans., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February 24-28 | 2,175 | 1,530 | 1,761 | 17,460 |
| March | 1,335 | 180 | 453 | 27,850 |
| April | 16,300 | 225 | 3,126 | 186,000 |
| May | 14,430 | 1,735 | 5,772 | 354,900 |
| June | 5,800 | 370 | 3,285 | 195,500 |
| July | 1,070 | 2 | 86.0 | 5,288 |
| August | 3,948 | 2 | 545 | 33,510 |
| September | 60 | 2 | 17.1 | 1,018 |
| October | 35 | 1 | 9.8 | 603 |
| The period | | | | 822,100 |

NOTE.—No estimate for ice period.

## ARKANSAS RIVER AT HUTCHINSON, KANS.

This station was established May 13, 1895, and was discontinued October 31, 1905. It is located at the wagon bridge at the south end of Main street, Hutchinson, Kans.

The channel is straight for some distance above and below the bridge and has a width of 1,020 feet, broken by 11 steel piers. The bed is sandy and very shifting, necessitating frequent discharge measurements and soundings. At low water the stream subdivides into a number of small channels.

Discharge measurements are made from the bridge at high water; at low water they can be made by wading.

The gage is a staff fastened to the downstream pier of the third bent from the north end of the bridge. During 1905 the gage was read once each day by George E. Dixon. Bench marks were established as follows: (1) The upper crosspiece of the pier guard; elevation, 8.35 feet. (2) The top of the iron doorsill of the first brick building next to the river; elevation, 8.12 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 232-233; 20, iv, p 342-343; Bull 140, pp 160-161; WS 16, p 124; 28, p 109; 37, p 265; 50, p 330; 66, p 56; 84, p 120; 99, p 266; 131, p 139.

Discharge: Ann 18, iv, p 233; Bull 140, p 161; WS 16, p 124; 28, p 116; 37, p 265; 50, p 330; 66, p 56; 84, p. 121; 99, p 266; 131, p 139.

Discharge, monthly: Ann 18, iv, p 234; 19, iv, p 361; 20, iv, pp 329, 343; 21, iv, p 236; 22, iv, p 344; Bull 140, p 162; WS 75, p 147; 84, p 122; 99, p 267; 131, p 141.

**Discharge, yearly:** Ann 20, iv, p 57.

**Gage heights:** Bull 140, p 161; WS 11, p 62; 16, p 124; 28, p 114; 37, p 265; 50, p 330; 66, p 56; 84, p 121; 99, pp 266-267; 131, p 140.

**Hydrographs:** Ann 18, iv, p 234; 19, iv, p 361; 20, iv, p 343; 21, iv, p 237; 22, iv, p 344; WS 75, p 148.

**Rainfall and run-off relation:** Ann 20 iv, p 330.

**Rating tables:** Ann 18, iv, p 234; 19, iv, p 360; WS 28, p 117; 39, p 450; 52, p 518; 66, p 172; 84, p 122; 99, p 267; 131, p 140.

*Discharge measurements of Arkansas River at Hutchinson, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 20 | W. G. Russell | 398 | 554 | 2.58 | 2.80 | 1,432 |
| May 26 | do | 762 | 1,505 | 3.83 | 4.80 | 5,764 |
| June 12 | do | 532 | 1,250 | 3.19 | 4.20 | 3,985 |
| June 13 | do | 668 | 1,442 | 3.31 | 4.55 | 4,779 |
| June 14 | do | 568 | 1,164 | 3.18 | 4.15 | 3,697 |
| August 3 | do | 408 | 469 | 2.26 | 2.60 | 1,059 |
| August 20 | do | 312 | 228 | 1.96 | 1.85 | 446 |
| September 23 | do | 131 | 87 | 1.85 | 1.40 | 161 |

*Daily gage height, in feet, of Arkansas River at Hutchinson, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.95 | 2.25 | 3.48 | 2.05 | 5.57 | 5.0 | 3.2 | 2.6 | 1.4 | 1.3 |
| 2 | 1.95 | 2.25 | 3.4 | 2.0 | 5.5 | 5.0 | 3.25 | 2.5 | 1.32 | 1.3 |
| 3 | 1.95 | 2.25 | 3.4 | 2.05 | 5.15 | 4.75 | 3.2 | 2.5 | 1.22 | 1.3 |
| 4 | 1.95 | 2.25 | 3.25 | 2.05 | 4.85 | 4.4 | 3.05 | 2.8 | 1.2 | 1.3 |
| 5 | 1.95 | 2.25 | 3.05 | 2.05 | 4.7 | 4.2 | 3.0 | 2.9 | 1.2 | 1.3 |
| 6 | 1.85 | 2.25 | 3.0 | 2.1 | 4.5 | 3.95 | 2.7 | 3.0 | 2.2 | 1.25 |
| 7 | 1.75 | 2.25 | 2.9 | 3.82 | 4.5 | 3.6 | 2.45 | 3.4 | 2.15 | 1.2 |
| 8 | 1.55 | 2.25 | 2.9 | 3.45 | 4.4 | 3.5 | 2.25 | 3.5 | 1.95 | 1.2 |
| 9 | 1.5 | 2.25 | 2.8 | 3.3 | 4.6 | 3.35 | 2.2 | 3.4 | 1.9 | 1.2 |
| 10 | 1.5 | 2.25 | 2.7 | 3.18 | 4.45 | 3.3 | 2.2 | 3.25 | 1.9 | 1.2 |
| 11 | 1.5 | 2.25 | 2.6 | 3.05 | 4.25 | 4.3 | 2.22 | 3.05 | 1.9 | 1.2 |
| 12 | 1.5 | 2.25 | 2.6 | 2.95 | 4.05 | 4.1 | 2.3 | 2.75 | 1.9 | 1.2 |
| 13 | 1.5 | 2.25 | 2.52 | 2.9 | 3.85 | 4.4 | 2.2 | 2.4 | 1.85 | 1.15 |
| 14 | 1.5 | 2.25 | 2.4 | 2.8 | 3.9 | 4.2 | 2.05 | 2.3 | 1.8 | 1.15 |
| 15 | 1.5 | 2.2 | 2.4 | 2.7 | 3.8 | 4.3 | 1.92 | 2.3 | 1.75 | 1.15 |
| 16 | 1.5 | 2.15 | 2.4 | 2.7 | 3.85 | 4.6 | 1.9 | 2.25 | 1.7 | 1.15 |
| 17 | 1.6 | 2.05 | 2.4 | 2.75 | 3.85 | 4.35 | 1.9 | 2.2 | 1.65 | 1.15 |
| 18 | 1.7 | 2.0 | 2.5 | 2.8 | 3.75 | 4.25 | 1.85 | 2.1 | 1.6 | 1.2 |
| 19 | 1.7 | 2.0 | 2.5 | 2.75 | 3.8 | 4.15 | 1.8 | 1.96 | 1.55 | 1.2 |
| 20 | 1.8 | 2.0 | 2.6 | 2.75 | 3.85 | 4.1 | 1.8 | 1.85 | 1.5 | 1.2 |
| 21 | 1.95 | 2.25 | 2.5 | 2.7 | 4.05 | 4.0 | 1.7 | 1.9 | 1.45 | 1.2 |
| 22 | 2.2 | 2.4 | 2.4 | 2.7 | 3.95 | 3.85 | 1.77 | 1.87 | 1.4 | 1.2 |
| 23 | 2.2 | 2.5 | 2.3 | 2.6 | 4.8 | 4.2 | 1.8 | 1.8 | 1.4 | 1.2 |
| 24 | 2.2 | 2.5 | 2.2 | 2.6 | 5.2 | 3.65 | 1.85 | 1.7 | 1.35 | 1.2 |
| 25 | 2.2 | 2.78 | 2.2 | 2.7 | 4.8 | 3.5 | 1.7 | 1.67 | 1.35 | 1.2 |
| 26 | 2.25 | 3.5 | 2.2 | 2.82 | 4.65 | 3.4 | 1.7 | 1.62 | 1.35 | 1.2 |
| 27 | 2.25 | 2.9 | 2.15 | 4.1 | 4.95 | 3.15 | 1.7 | 1.6 | 1.35 | 1.2 |
| 28 | 2.25 | 3.5 | 2.1 | 5.42 | 4.9 | 3.15 | 1.7 | 1.6 | 1.35 | 1.2 |
| 29 | 2.25 | ........ | 2.1 | 5.4 | 4.95 | 2.92 | 1.7 | 1.5 | 1.3 | 1.2 |
| 30 | 2.25 | ........ | 2.05 | 5.4 | 5.05 | 3.15 | 2.4 | 1.4 | 1.3 | 1.25 |
| 31 | 2.25 | ........ | 2.05 | ........ | 5.58 | ........ | 2.6 | 1.4 | ........ | 1.3 |

*Station rating table for Arkansas River at Hutchinson, Kans., from January 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 80 | 2.20 | 660 | 3.30 | 2,065 | 4.40 | 4,390 |
| 1.20 | 95 | 2.30 | 750 | 3.40 | 2,240 | 4.50 | 4,650 |
| 1.30 | 120 | 2.40 | 850 | 3.50 | 2,420 | 4.60 | 4,920 |
| 1.40 | 150 | 2.50 | 960 | 3.60 | 2,605 | 4.70 | 5,205 |
| 1.50 | 190 | 2.60 | 1,070 | 3.70 | 2,800 | 4.80 | 5,500 |
| 1.60 | 240 | 2.70 | 1,190 | 3.80 | 3,005 | 4.90 | 5,800 |
| 1.70 | 300 | 2.80 | 1,320 | 3.90 | 3,220 | 5.00 | 6,100 |
| 1.80 | 360 | 2.90 | 1,460 | 4.00 | 3,440 | 5.20 | 6,730 |
| 1.90 | 430 | 3.00 | 1,600 | 4.10 | 3,670 | 5.40 | 7,380 |
| 2.00 | 500 | 3.10 | 1,750 | 4.20 | 3,900 | 5.60 | 8,050 |
| 2.10 | 580 | 3.20 | 1,900 | 4.30 | 4,140 | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905, and is fairly well defined.

*Estimated monthly discharge of Arkansas River at Hutchinson, Kans., for 1905.*

[Drainage area, 34,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 705 | 190 | 430 | 26,440 | 0.013 | 0.015 |
| February | 2,420 | 500 | 866 | 48,100 | .025 | .026 |
| March | 2,384 | 540 | 1,112 | 68,370 | .033 | .038 |
| April | 7,446 | 500 | 1,965 | 116,900 | .058 | .065 |
| May | 7,982 | 2,902 | 4,838 | 297,500 | .142 | .164 |
| June | 6,100 | 1,488 | 3,470 | 206,500 | .102 | .114 |
| July | 1,982 | 300 | 743 | 45,680 | .022 | .025 |
| August | 2,420 | 150 | 882 | 54,230 | .026 | .030 |
| September | 660 | 95 | 257 | 15,290 | .0076 | .0085 |
| October | 120 | 88 | 99.5 | 6,118 | .0029 | .0033 |
| The period | | | | 885,100 | | |

## ARKANSAS RIVER AT ARKANSAS CITY, KANS.

This station was established September 23, 1902, by W. G. Russell. It is located on the Chestnut Avenue Bridge, one-half mile west of Arkansas City, Kans.

The channel is straight for about 200 feet above and below the station and has a width of 550 feet, broken by 36 pile piers. Both banks are low and liable to overflow. The bed of the river is sandy and shifting. The current is moderately rapid.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank.

The gage is a staff fastened to the downstream pile of the second bent from the east end of the bridge. During 1905 the gage was read daily by T. C. White. Bench marks were established as follows: (1) the top of the cap on the pile which carries the gage; elevation, 17.20 feet. (2) A nail driven into the south pile of the bent of the east abutment; elevation, 11.97 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 84, p 119; 99, p 263; 131, p 141.
Discharge: 84, p 119; 99, p 264; 131, p 142.
Discharge, monthly: 99, p 265; 131, p 144.
Gage heights: 84, p 120; 99, p 264; 131, p 142.
Rating table: 99, p 265; 131, p 143.

*Discharge measurements of Arkansas River at Arkansas City, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 21 | W. G. Russell | 219 | 541 | 2.60 | 4.40 | 1,407 |
| May 5 | do | 366 | 1,767 | 3.79 | 7.70 | 6,693 |
| May 6 | do | 345 | 1,579 | 3.59 | 7.30 | 5,672 |
| June 15 | do | 325 | 1,459 | 3.10 | 6.90 | 4,529 |
| July 27 | do | 156 | 398 | 1.39 | 3.30 | 553 |
| August 21 | do | 197 | 407 | 2.22 | 3.90 | 905 |
| September 27 | do | 170 | 432 | 1.30 | 3.55 | 564 |

*Daily gage height, in feet, of Arkansas River at Arkansas City, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.1 | 4.1 | 5.4 | 4.3 | 8.7 | 9.0 | 5.0 | 7.6 | 2.5 | 3.2 |
| 2 | 3.1 | 4.0 | 5.6 | 4.2 | 9.0 | 9.3 | 5.2 | 7.0 | 2.4 | 3.1 |
| 3 | 3.0 | 3.8 | 5.7 | 4.1 | 9.2 | 9.2 | 5.6 | 6.0 | 3.2 | 2.9 |
| 4 | 3.0 | 3.7 | 5.8 | 4.2 | 8.3 | 8.5 | 7.0 | 5.5 | 2.2 | 2.9 |
| 5 | 2.9 | 3.8 | 5.8 | 4.1 | 7.7 | 8.1 | 8.1 | 5.4 | 2.2 | 2.8 |
| 6 | 2.8 | 3.8 | 5.7 | 4.0 | 7.3 | 7.8 | 7.4 | 5.3 | 2.1 | 2.8 |
| 7 | 2.8 | 3.9 | 5.7 | 4.3 | 7.1 | 7.6 | 7.1 | 5.2 | 2.5 | 2.7 |
| 8 | 2.9 | 4.1 | 5.7 | 4.8 | 6.8 | 7.1 | 7.1 | 5.1 | 3.0 | 2.7 |
| 9 | 3.0 | 4.2 | 5.6 | 4.9 | 7.1 | 6.4 | 6.7 | 5.4 | 3.2 | 2.7 |
| 10 | 3.1 | 3.9 | 5.6 | 5.7 | 7.2 | 6.2 | 5.7 | 5.3 | 4.0 | 2.7 |
| 11 | 3.0 | 3.8 | 5.5 | 5.9 | 7.3 | 6.3 | 5.5 | 5.2 | 4.7 | 2.6 |
| 12 | 3.0 | 3.9 | 5.1 | 5.8 | 6.7 | 6.2 | 5.0 | 5.1 | 4.1 | 2.6 |
| 13 | 2.9 | 3.8 | 4.5 | 4.9 | 6.6 | 5.4 | 4.8 | 5.1 | 5.0 | 2.6 |
| 14 | 2.9 | 3.8 | 4.6 | 4.5 | 6.5 | 6.5 | 4.7 | 4.8 | 5.2 | 2.6 |
| 15 | 2.9 | 3.8 | 4.5 | 4.3 | 6.0 | 6.9 | 4.6 | 4.6 | 5.1 | 2.6 |
| 16 | 2.8 | 3.7 | 4.4 | 4.3 | 5.8 | 6.3 | 4.5 | 4.5 | 4.8 | 2.5 |
| 17 | 2.9 | 3.7 | 4.4 | 4.2 | 5.8 | 6.6 | 4.4 | 4.4 | 4.4 | 2.4 |
| 18 | 2.9 | 3.6 | 4.3 | 4.2 | 5.9 | 7.0 | 4.2 | 4.3 | 4.8 | 2.5 |
| 19 | 3.1 | 3.7 | 4.5 | 4.1 | 5.7 | 7.1 | 4.0 | 4.2 | 6.8 | 2.5 |
| 20 | 3.3 | 3.7 | 4.6 | 4.0 | 5.7 | 7.2 | 3.1 | 4.1 | 6.6 | 2.5 |
| 21 | 3.5 | 3.8 | 4.7 | 4.4 | 5.9 | 7.1 | 3.8 | 3.9 | 5.5 | 2.5 |
| 22 | 3.6 | 3.7 | 4.6 | 4.2 | 6.0 | 7.0 | 3.7 | 3.7 | 5.2 | 2.5 |
| 23 | 3.6 | 3.8 | 4.5 | 4.3 | 6.2 | 6.1 | 3.6 | 3.7 | 4.8 | 2.5 |
| 24 | 3.7 | 3.8 | 4.5 | 4.3 | 7.5 | 6.9 | 3.6 | 3.6 | 4.3 | 2.5 |
| 25 | 3.8 | 3.7 | 4.1 | 4.5 | 7.1 | 6.8 | 3.5 | 3.1 | 3.8 | 2.5 |
| 26 | 3.8 | 5.1 | 4.4 | 4.8 | 8.4 | 6.0 | 3.4 | 3.0 | 3.7 | 2.6 |
| 27 | 4.1 | 5.3 | 4.5 | 4.9 | 7.7 | 5.8 | 3.3 | 2.1 | 3.6 | 2.6 |
| 28 | 4.2 | 5.3 | 4.4 | 5.0 | 7.7 | 5.6 | 3.1 | 2.9 | 3.5 | 2.7 |
| 29 | 4.3 | ........ | 4.3 | 5.9 | 7.2 | 5.3 | 3.0 | 2.8 | 3.4 | 3.6 |
| 30 | 4.3 | ........ | 4.4 | 8.8 | 7.6 | 5.2 | 5.0 | 2.7 | 3.3 | 2.8 |
| 31 | 4.2 | ........ | 4.3 | ........ | 9.3 | ........ | 7.7 | 2.6 | ........ | 3.0 |

NOTE.—River frozen January 1 to February 25, approximately.

*Station rating table for Arkansas River at Arkansas City, Kans., from January 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.10 | 75 | 3.60 | 670 | 5.10 | 2,190 | 7.20 | 5,440 |
| 2.20 | 82 | 3.70 | 750 | 5.20 | 2,310 | 7.40 | 5,800 |
| 2.30 | 90 | 3.80 | 840 | 5.30 | 2,440 | 7.60 | 6,160 |
| 2.40 | 100 | 3.90 | 930 | 5.40 | 2.570 | 7.80 | 6,540 |
| 2.50 | 112 | 4.00 | 1,020 | 5.50 | 2,700 | 8.00 | 6,920 |
| 2.60 | 128 | 4.10 | 1,110 | 5.60 | 2,840 | 8.20 | 7,330 |
| 2.70 | 150 | 4.20 | 1,210 | 5.70 | 2,980 | 8.40 | 7,750 |
| 2.80 | 180 | 4.30 | 1,310 | 5.80 | 3,120 | 8.60 | 8,170 |
| 2.90 | 220 | 4.40 | 1,410 | 5.90 | 3,270 | 8.80 | 8,595 |
| 3.00 | 270 | 4.50 | 1,510 | 6.00 | 3,420 | 9.00 | 9,025 |
| 3.10 | 320 | 4.60 | 1.620 | 6.20 | 3,730 | 9.20 | 9,460 |
| 3.20 | 380 | 4.70 | 1,730 | 6.40 | 4,050 | 9.40 | 9,900 |
| 3.30 | 440 | 4.80 | 1,840 | 6.60 | 4,380 | 9.60 | 10,360 |
| 3.40 | 510 | 4.90 | 1,950 | 6.80 | 4,720 | | |
| 3.50 | 590 | 5.00 | 2,070 | 7.00 | 5,080 | | |

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is fairly well defined between gage heights 3.3 feet and 8 feet. Above 8 feet this table is the same as table for 1904.

*Estimated monthly discharge of Arkansas River at Arkansas City, Kans., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 3,120 | 1,110 | 1,996 | 122,700 |
| April | 3,270 | 1,020 | 1,702 | 101,300 |
| May | 9,680 | 2,980 | 5,422 | 333,400 |
| June | 9,680 | 2,310 | 5,000 | 297,500 |
| July | 7,125 | 270 | 2,333 | 143,400 |
| August | 6,160 | 75 | 1,710 | 105,100 |
| September | 4,720 | 75 | 1,272 | 75,690 |
| October | 670 | 100 | 173 | 10,640 |
| The period | | | | 1,190,000 |

NOTE. No estimate for ice period.

## SALT FORK OF ARKANSAS RIVER NEAR ALVA, OKLA.

This station was established September 10, 1903, by W. G. Russell, and was discontinued December 31, 1905 It is located at the railway bridge about one-half mile northeast of Alva, Okla.

The channel is curved for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The bed of the stream is composed of clean sand, and is shifting. There are one or more channels at low water and one at high water, divided by piers and piles.

Discharge measurements are made from the upper side of the deck railway bridge, or by wading at low stages. This bridge is composed of 146 feet of pile approach at the south end, four 80-foot steel girders resting on stone piers, and 652 feet of pile approach at the north end. The initial point for soundings is at the south end.

A standard chain gage is fastened to the upstream guard rail of the bridge; length of chain 23.00 feet. There is also a gage painted on the fourth pier from the south end of the bridge. The sinking of the river bed may cause minus readings at very low water. During

1905 the gage was read once each day by James P. Richmond. The bench mark is the bottom of the coping stone on the north face of the fourth pier from the south end of the bridge; elevation, 8.00 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 144–145.

*Discharge measurements of Salt Fork of Arkansas River near Alva, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 30 | W. G. Russell | 82 | 25 | 1.16 | 0.35 | 29 |
| June 6 | J. M. Giles | 20 | 5 | .88 | .20 | 4.4 |
| June 21 | Earl Patterson | 328 | 190 | 1.93 | 1.10 | 368 |
| July 20 | ....do | 22 | 7 | .85 | .30 | 6 |
| August 18 | ....do | | 37 | 1.22 | .80 | 45 |
| August 30 | J. M. Giles | | 7.6 | 1.71 | .55 | 13 |
| September 21 | Earl Patterson | 40 | 20 | 1.29 | .50 | 26 |
| October 19 | J. M. Giles | 16 | 5 | .64 | .25 | 3 |
| October 27 | Earl Patterson | 16 | 5 | .52 | .20 | 2 |
| November 25 | ....do | | 74 | 1.25 | .80 | 92 |
| December 18 | ....do | 37 | 18 | 1.09 | .45 | 20 |

*Daily gage height, in feet, of Salt Fork of Arkansas River near Alva, Okla., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.0 | 0.3 | 0.4 | 1.0 | 1.1 | 0.4 | 0.3 | 0.3 | 0.4 |
| 2 | | .1 | .2 | .4 | 3.3 | .8 | .3 | .3 | .4 | .4 |
| 3 | | .4 | .1 | .4 | 3.0 | .5 | 4.8 | .3 | .4 | .4 |
| 4 | | .3 | .1 | .3 | 2.0 | .4 | 2.8 | .3 | .4 | .4 |
| 5 | | .2 | .1 | .2 | 1.0 | .2 | 1.6 | .3 | 1.1 | .4 |
| 6 | | .1 | .1 | .2 | .5 | .0 | 1.3 | .3 | .7 | .4 |
| 7 | | .1 | .1 | .2 | .3 | .6 | .8 | .3 | .5 | .4 |
| 8 | | .1 | .1 | .2 | .3 | .3 | .5 | .3 | .4 | .4 |
| 9 | | .1 | 1.0 | .2 | 1.0 | .3 | .3 | .3 | .4 | .4 |
| 10 | | .1 | .7 | .2 | 1.5 | .3 | 2.2 | .3 | .4 | .4 |
| 11 | | .1 | .4 | .2 | .8 | .3 | 1.1 | .3 | .5 | .4 |
| 12 | 0.3 | .1 | .3 | .2 | .8 | .3 | .9 | .3 | .4 | .4 |
| 13 | .3 | .1 | .2 | .2 | .5 | 3.8 | .8 | .3 | .4 | .4 |
| 14 | .3 | .1 | .1 | .2 | .3 | 2.0 | .8 | .3 | .4 | .4 |
| 15 | .3 | .1 | .1 | .2 | .3 | 1.7 | .6 | .3 | .4 | .4 |
| 16 | .4 | .1 | .1 | .2 | .1 | 1.3 | .6 | .3 | .4 | .4 |
| 17 | .5 | .1 | .1 | .2 | .0 | .9 | 1.5 | .3 | .4 | .4 |
| 18 | .9 | .1 | .1 | .1 | .0 | .4 | 1.9 | .3 | .4 | .4 |
| 19 | .5 | .1 | .1 | 2.0 | .0 | .3 | 1.0 | .3 | .4 | .4 |
| 20 | .5 | .2 | .1 | 1.5 | .3 | 4.8 | .8 | .3 | .4 | .4 |
| 21 | .3 | .1 | .1 | 1.5 | .3 | 2.8 | .7 | .3 | .4 | .4 |
| 22 | .2 | .1 | .1 | 1.0 | .3 | 1.6 | .6 | .3 | .4 | .4 |
| 23 | .2 | .1 | .6 | .7 | .3 | 1.3 | .5 | .3 | 1.7 | .4 |
| 24 | .2 | .1 | .6 | .7 | .3 | 1.0 | .4 | .3 | 1.3 | .4 |
| 25 | .2 | .1 | .6 | .6 | .3 | .9 | .4 | .4 | .8 | .4 |
| 26 | .2 | .1 | .4 | .5 | .3 | .7 | .3 | .4 | .7 | .4 |
| 27 | .2 | .1 | .4 | .4 | .3 | .7 | .3 | .3 | .6 | .4 |
| 28 | .1 | .4 | .4 | .3 | 1.6 | .7 | .3 | .3 | .5 | .4 |
| 29 | .0 | .3 | .4 | .2 | 1.0 | .7 | .3 | .3 | .4 | .4 |
| 30 | .0 | .35 | .4 | .2 | 1.8 | .7 | .3 | .3 | .4 | .4 |
| 31 | .0 | | .4 | | 1.5 | .4 | | .3 | | .4 |

## SALT FORK OF ARKANSAS RIVER NEAR TONKAWA, OKLA.

This station was established September 18, 1903, by W. G. Russell. It is located at the highway bridge one-half mile south of Tonkawa, Okla.

The channel is straight for about 200 feet above and below the station. The current is sluggish at low and swift at high stages. The right bank is low, wooded, and subject to overflow. The left bank is high, wooded, and does not overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at low and high stages, broken only by the pile bents supporting the bridge.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is at the north end of the bridge.

The gage is a staff fastened vertically to the downstream pile of a bent 198 feet from the north end of the bridge. During 1905 the gage was read by T. J. Bird. The bench mark is the top of a nail driven into a 6-inch cottonwood tree about 40 feet east of the north end of the bridge; elevation, 10.50 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 145–147.

*Discharge measurements of Salt Fork of Arkansas River near Tonkawa, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 29 | W. G. Russell | 208 | 148 | 0.68 | 1.35 | 101 |
| July 28 | do | 319 | 546 | 1.34 | 2.50 | 735 |
| August 18 | Earl Patterson | 48 | 37 | 1.22 | .80 | 45 |
| August 30 | J. M. Giles | 16 | 8 | 1.71 | .55 | 13 |
| September 26 | W. G. Russell | 163 | 164 | .90 | 1.45 | 147 |

*Daily gage height, in feet, of Salt Fork of Arkansas River near Tonkawa, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.5 | 2.3 | 1.5 | 1.3 | 1.6 | 1.7 | 2.1 | 0.9 | 1.2 |
| 2 | 1.4 | 1.5 | 2.0 | 2.4 | 1.2 | 2.4 | 2.4 | 3.2 | .9 | 1.2 |
| 3 | 1.3 | 1.5 | 1.9 | 3.5 | 1.2 | 2.4 | 3.1 | 2.5 | 1.0 | 1.2 |
| 4 | 1.3 | 1.5 | 1.8 | 2.7 | 1.3 | 2.0 | 2.8 | 2.1 | 1.8 | 1.3 |
| 5 | 1.4 | .9 | 1.8 | 2.0 | 1.3 | 1.9 | 2.9 | 1.9 | 1.8 | 1.3 |
| 6 | 1.4 | .9 | 1.8 | 1.9 | 1.3 | 1.8 | 2.2 | 1.8 | 2.0 | 1.2 |
| 7 | 1.5 | .9 | 1.9 | 1.8 | 1.3 | 1.9 | 1.9 | 1.6 | 2.4 | 1.2 |
| 8 | 1.5 | .9 | 1.9 | 1.7 | 1.3 | 1.9 | 1.9 | 1.6 | 5.4 | 1.2 |
| 9 | 1.5 | .9 | 2.2 | 1.6 | 1.4 | 2.0 | 1.8 | 1.4 | 4.2 | 1.2 |
| 10 | 1.5 | .9 | 2.5 | 1.5 | 1.7 | 1.9 | 2.3 | 1.6 | 3.8 | 1.2 |
| 11 | 1.5 | .9 | 2.0 | 1.5 | 1.3 | 1.6 | 2.6 | 1.6 | 3.1 | 1.2 |
| 12 | 1.5 | .9 | 1.9 | 1.5 | 1.1 | 1.4 | 1.9 | 1.6 | 2.8 | 1.2 |
| 13 | 1.5 | .9 | 1.8 | 1.5 | 1.4 | 1.4 | 1.8 | 2.2 | 2.8 | 1.2 |
| 14 | 1.5 | .9 | 1.9 | 1.5 | 1.8 | 1.3 | 1.8 | 7.8 | 2.7 | 1.2 |
| 15 | 1.5 | .9 | 1.9 | 1.5 | 1.6 | 1.3 | 1.6 | 5.8 | 2.4 | 1.2 |
| 16 | 1.5 | .9 | 1.8 | 1.5 | 1.3 | 1.3 | 1.5 | 4.5 | 2.0 | 1.2 |
| 17 | 1.5 | .9 | 1.9 | 1.5 | 1.3 | 1.3 | 1.4 | 3.9 | 1.7 | 1.2 |
| 18 | 1.5 | .9 | 2.2 | 1.6 | 1.3 | 1.2 | 1.3 | 3.0 | 1.7 | 1.2 |
| 19 | 1.5 | .9 | 2.8 | 1.5 | 1.3 | 1.2 | 1.2 | 2.3 | 1.7 | 1.2 |
| 20 | 1.5 | 1.2 | 1.8 | 1.5 | 1.3 | 1.2 | 1.2 | 2.6 | 1.5 | 1.2 |
| 21 | 1.5 | 1.6 | 1.5 | 1.4 | 1.3 | 1.2 | 1.6 | 2.6 | 1.6 | 1.2 |
| 22 | 1.5 | 2.1 | 1.7 | 1.3 | 1.3 | 3.9 | 1.3 | 2.6 | 1.5 | 1.3 |
| 23 | 1.5 | 2.6 | 2.0 | 1.2 | 1.3 | 2.9 | 3.0 | 2.9 | 1.4 | 1.2 |
| 24 | 1.5 | 2.8 | 1.9 | 1.2 | 1.3 | 2.8 | 4.0 | 3.0 | 1.2 | 1.2 |
| 25 | 1.5 | 2.6 | 1.8 | 1.3 | 1.3 | 2.6 | 4.3 | 2.6 | 1.0 | 1.2 |
| 26 | 1.5 | 2.6 | 1.6 | 1.3 | 1.3 | 1.2 | 3.0 | 2.0 | 1.0 | 1.2 |
| 27 | 1.5 | 2.4 | 1.6 | 1.3 | 2.8 | 1.9 | 2.8 | 1.9 | 1.2 | 1.2 |
| 28 | 1.5 | 2.3 | 1.6 | 1.2 | 2.6 | 1.6 | 2.5 | 1.8 | 1.2 | 1.3 |
| 29 | 1.5 | ........ | 1.5 | 1.2 | 2.6 | 1.5 | 2.0 | 1.6 | 1.2 | 1.2 |
| 30 | 1.5 | ........ | 1.5 | 1.3 | 2.6 | 1.7 | 1.9 | 1.0 | 1.2 | 1.3 |
| 31 | 1.5 | ........ | 1.5 | ........ | 2.4 | ........ | 1.9 | 1.0 | ........ | 1.4 |

## PURGATORY RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Purgatory River, a characteristic stream of eastern Colorado, is the principal tributary of Arkansas River in Colorado. It rises in the Culebra Mountains and flows northeastward across the plains for a distance of 165 miles. In the spring the channel carries a moderate volume of water, but as summer approaches this is greatly diminished by irrigation and natural conditions until the channel is practically dry. The volume of water contributed to the Arkansas is so small that it has no appreciable effect on the discharge of that river save at times of excessive rainfall, when it may discharge a large volume for a short time.

The drainage basin of Purgatory River is long and narrow. The total area is 3,386 square miles, of which 742 square miles, lying above Trinidad, are mountainous, the country being made up of shales, sandstones, and igneous rocks. This area is much broken by numerous stream channels, which are normally dry. The lower basin is largely foothill country, merging into rough plains farther east. Drainage lines are well defined throughout this area. For 60 miles of its length, commencing 25 miles below Trinidad, Purgatory River flows in a deep canyon. There are numerous small tributary canyons at various angles to the main channel. The soil of this lower basin is largely detritus from decomposed shales, sandstones, and similar soft sedimentary rocks. Erosion is still vigorous, and after a storm the flood waters often contain in suspension as much as 10 per cent (by volume) of silt.

In the mountainous portion the Weather Bureau records at Clearview for fifteen years give a mean annual rainfall of 23 inches; at Trinidad, ten years' record, 17 inches. The plains drainage has approximately a mean annual precipitation of 12 inches.

A characteristic feature of this stream is the occurrence of sudden and disastrous floods, which take place irregularly and are the run-off of excessive precipitation. In the spring periodic floods occur from melting snow, which is often supplemented by spring rains. During these floods large areas of the stream bank are eroded. The most disastrous flood on record occurred October 1, 1904.

No storage is practiced on this stream, though investigations are being made by a corporation with the purpose of constructing a large storage reservoir for use in irrigation.

No power has been developed, and because of the abundance of coal in the vicinity of Trinidad it is doubtful if power development would be feasible, even under very favorable circumstances.

## PURGATORY RIVER AT TRINIDAD, COLO.

This station was established May 1, 1896, at the Animas Street Bridge, the gage rod being attached to the cylindrical pier at the west end of the bridge. The station was, however, discontinued July 31, 1899, the greater portion of the water in the river being diverted above the gaging station; the channel was also shifting and results not satisfactory. July 25, 1905, the Trinidad station was reestablished, at the old location on the Animas Street Bridge, by R. I. Meeker. The reestablishment was for the purpose of collecting general hydrographic data, especially flood data.

The river channel is irregular in course at low water, but is generally straight above the bridge for a distance of a few hundred feet. Below, the channel is straight for a distance of 100 feet. The stream bed is composed of a loose deposit of cobblestones, graduating into coarse gravel and sand, and is more or less shifting. The left bank is a loose riprap of stone above the bridge, with piling below. The right bank consists of the riprap embankments of the Colorado and Southern Railway, and will overflow at extreme high water. There is usually but one channel at all stages. Velocity at low stages is sluggish, increasing to swift velocities during high stages.

Discharge measurements are made from the downstream footway. A standard chain gage is attached to the upstream footway of the bridge; length of chain, 22.52 feet. The gage scale reads from 0 to 10 feet, the chain having two markers, giving a range of 20 feet in gage heights. During 1905 the gage was read twice each day by Perry Foote. The bench mark is a cross cut within a circle on the porch of the house at No. 312 Nevada Avenue, about 300 feet north of the Animas Street Bridge; elevation, 14.99 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; WS=Water-Supply Papers):

Description: Ann 18, iv, pp 231-232; WS 16, p 123; 28, p 108; 37, p, 263.
Discharge: Ann 18, iv, p 232; WS 16, p 123; 28, p 116; 37 p 263.
Discharge, monthly: Ann 19, iv, p 359; 20, iv, pp 329, 341; 21, iv, p 235.
Discharge, yearly: Ann 20, iv, p 57.
Gage heights: WS 11, p 61; 16, p 123; 28, p 113; 37, p 263.
Hydrograph: Ann 19, iv, p 360; 20, iv, p 341; 21, iv, p 236.
Rainfall and run-off relation: Ann 20, iv, p 330.
Rating tables: Ann 19, iv, p 358; WS 28, p 117; 39, p 450.

*Discharge measurements of Purgatory River at Trinidad, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 25 | R. I. Meeker | 45 | 62 | 2.29 | | 142 |
| August 25 | do | 43 | 126 | 2.83 | 5.65 | 357 |
| August 26 | do | 35 | 73 | 1.97 | 5.10 | 144 |
| November 4 | do | 25 | 18 | 1.22 | 4.67 | 22 |

*Daily gage height, in feet, of Purgatory River at Trinidad, Colo., for 1905.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 5.05 | 4.52 | 4.65 | 5.0 | 17 | ....... | 4.55 | 4.65 | 4.7 | 5.0 |
| 2 | ....... | 4.75 | 4.58 | 4.75 | 5.0 | 18 | ....... | 4.62 | 4.6 | 4.7 | 5.2 |
| 3 | ....... | 4.7 | 4.6 | 4.72 | 5.0 | 19 | ....... | 4.68 | 4.55 | 4.7 | 5.2 |
| 4 | ....... | 5.35 | 4.55 | 4.7 | 4.9 | 20 | ....... | 4.65 | 4.6 | 4.7 | 5.0 |
| 5 | ....... | 4.7 | 4.58 | 4.7 | 4.9 | 21 | ....... | 4.6 | 4.58 | 4.7 | 5.0 |
| 6 | ....... | 5.0 | 4.6 | 4.7 | 4.9 | 22 | ....... | 4.6 | 4.55 | 4.85 | 5.1 |
| 7 | ....... | 5.1 | 4.52 | 4.65 | 4.9 | 23 | ....... | 4.58 | 4.58 | 4.85 | 5.2 |
| 8 | ....... | 4.88 | 4.5 | 4.52 | 4.95 | 24 | ....... | 4.5 | 4.68 | 4.7 | 5.2 |
| 9 | ....... | 4.95 | 4.6 | 4.72 | 5.0 | 25 | ....... | 4.58 | 4.6 | 4.7 | 5.2 |
| 10 | ....... | 4.92 | 4.52 | 4.7 | 5.0 | 26 | 5.05 | 4.6 | 4.62 | 4.7 | 5.2 |
| 11 | ....... | 4.78 | 4.68 | 4.7 | 5.0 | 27 | 4.9 | 4.7 | 4.6 | 4.7 | 5.2 |
| 12 | ....... | 4.72 | 4.6 | 4.7 | 5.0 | 28 | 4.95 | 4.7 | 4.65 | 4.9 | 5.2 |
| 13 | ....... | 4.68 | 4.6 | 4.7 | 4.88 | 29 | 4.8 | 4.55 | 4.65 | 4.7 | 5.2 |
| 14 | ....... | 4.62 | 4.6 | 4.7 | 4.88 | 30 | 4.85 | 4.58 | 4.65 | 4.7 | 5.2 |
| 15 | ....... | 4.6 | 4.6 | 4.7 | 5.0 | 31 | 4.8 | ....... | 4.65 | ....... | 5.2 |
| 16 | ....... | 4.58 | 4.58 | 4.7 | 5.3 | | | | | | |

*Station rating table for Purgatory River at Trinidad, Colo., from August 27 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.50 | 11 | 4.90 | 81 | 5.30 | 215 | 5.70 | 375 |
| 4.60 | 17 | 5.00 | 111 | 5.40 | 253 | 5.80 | 421 |
| 4.70 | 31 | 5.10 | 144 | 5.50 | 293 | 5.90 | 468 |
| 4.80 | 55 | 5.20 | 179 | 5.60 | 333 | | |

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. It is fairly well defined.

*Estimated monthly discharge of Purgatory River at Trinidad, Colo., for 1905.*

[Drainage area, 742 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| August 26-31 | 128 | 55 | 80.5 | 958 | 0.108 | 0.024 |
| September | 234 | 11 | 47.3 | 2,815 | .064 | .071 |
| October | 28 | 11 | 17.7 | 1,088 | .024 | .028 |
| November | 68 | 12 | 34.8 | 2,071 | .047 | .052 |
| December | 215 | 76 | 133 | 8,178 | .179 | .206 |
| The period | | | | 15,110 | | |

## PURGATORY RIVER NEAR ALFALFA, COLO.

This station was established March 23, 1905, by R. I. Meeker. It is located one-eighth of a mile below the canyon entrance, 4 miles east of Alfalfa post-office, and about 25 miles east of Trinidad, in T. 33 S., R. 60 W.

The channel is straight for 200 feet above and below the cable, and is composed primarily of large fragments of sandstone; on top of these and along the sides of the channel is a shifting bed of sand, which is deposited at low water and reaches a depth of at least 2 feet; above gage height 7 feet this deposit is usually scoured out. The current of Purgatory River is very swift and beds of sand are rapidly deposited and scoured out during a year's time. The right bank, which is the canyon side, is a talus slope composed largely of fragments of sandstone from the vertical wall above, the interstices and intervening stretches being filled by a deposit of sand. The left bank is of sand, about 8 feet high, gradually sloping into the talus above. Above the talus slopes on either side the canyon walls are vertical for 75 feet. Except at very low water there is more or less boiling of the current, which interferes during measurements. At high water the velocity is swift.

Discharge measurements are made by means of a cable, car, stay wire, and tagged wire. The initial point for soundings is the zero mark of the tagged line at the right bank, near the face of the large bowlder to which the cable is anchored. At low water, discharge measurements are often made by wading.

The permanent gage is an inclined staff bolted to a large sandstone bowlder on the right bank of the stream, 15 feet below the cable. From 10 to 20 feet the gage consists of a vertical staff bolted to an immense bowlder to which the righthand end of the cable is anchored. After the high water of 1905 the channel filled in with sand so that the little water that was in the river flowed along the left bank. August 7 a temporary rod was established on the left bank at the same datum as the permanent gage. This rod is a staff driven vertically into the river bed at left bank. During 1905 the gage was read once each day during ordinary and twice or more during varying stages, by Leigh Bull. The bench mark is a dash cut in the bowlder to which the vertical portion of the original rod is attached; elevation, 10.00 feet above the datum of the gage.

*Discharge measurements of Purgatory River near Alfalfa, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 24 | R. I. Meeker | 83 | 90 | 2.51 | 4.85 | 226 |
| March 28 | L. D. Bull | 83 | 100 | 1.80 | 4.40 | 180 |
| April 17 | do | 83 | 130 | 2.46 | 5.20 | 320 |
| April 25 | do | 85 | 328 | 3.86 | 7.35 | 1,265 |
| May 4 | do | 95 | 194 | 3.78 | 6.35 | 734 |
| May 17 | do | 85 | 100 | 3.68 | 5.10 | 368 |
| May 21 | do | 90 | 140 | 4.04 | 6.05 | 565 |
| May 29 | do | 90 | 120 | 3.25 | 5.25 | 393 |
| June 11 | do | 90 | 110 | 3.65 | 5.50 | 402 |
| July 23 | do | 90 | 150 | 4.35 | 6.28 | 653 |
| August 3 | do | 96 | 110 | 4.34 | 5.80 | 478 |
| August 7 | R. I. Meeker | 37 | 53 | 2.74 | 4.00 | 145 |
| August 8 | L. D. Bull | 36 | 47 | 2.55 | 3.80 | 120 |
| August 12 | do | 43 | 56 | 2.62 | 4.00 | 147 |
| August 19 | do | 30 | 11.3 | .85 | 2.65 | 9.6 |
| August 25 | do | 94 | 170 | 5.08 | 6.80 | 866 |
| September 2 | do | 75 | 52 | 1.86 | 3.88 | 97 |
| September 8 | do | 68 | 46 | 1.89 | 3.55 | 87 |
| September 21 | do | 28 | 8.7 | .78 | 2.60 | 6.8 |
| October 11 | do | 28 | 7.2 | .53 | 2.55 | 3.8 |
| November 26 | do | 22 | 6 | .83 | 2.55 | 5 |
| December 3 | do | 26 | 15 | 1.07 | 2.80 | 16 |
| December 14 | do | 26 | 24 | .88 | 3.20 | 21 |

*Daily gage height, in feet, of Purgatory River near Alfalfa, Colo., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 7.2 | 7.5 | 5.5 | 2.75 | 4.0 | 3.95 | 2.65 | 2.45 | 2.8 |
| 2 | ........ | 5.66 | 7.3 | 5.4 | 2.6 | 5.0 | 3.9 | 2.65 | 2.45 | 2.8 |
| 3 | ........ | 5.45 | 6.8 | 5.3 | 2.5 | 6.1 | 3.7 | 2.6 | 2.45 | 2.8 |
| 4 | ........ | 6.24 | 6.4 | 5.3 | 2.4 | 3.8 | 3.35 | 2.6 | 2.45 | 2.8 |
| 5 | ........ | 5.9 | 5.85 | 5.75 | 2.3 | 3.9 | 3.5 | 2.6 | 2.45 | 2.8 |
| 6 | ........ | 6.6 | 5.4 | 5.6 | 2.2 | 3.9 | 5.1 | 2.6 | 2.45 | 2.75 |
| 7 | ........ | 6.6 | 5.25 | 5.5 | 2.1 | 3.9 | 4.2 | 2.55 | 2.4 | 2.75 |
| 8 | ........ | 6.45 | 5.3 | 6.0 | 2.15 | 3.8 | 3.8 | 2.55 | 2.45 | 3.1 |
| 9 | ........ | 6.55 | 5.1 | 5.8 | 2.0 | 3.7 | 3.35 | 2.55 | 2.45 | 3.2 |
| 10 | ........ | 6.3 | 5.6 | 5.4 | 1.9 | 3.65 | 3.15 | 2.55 | 2.45 | 3.0 |
| 11 | ........ | 6.0 | 5.2 | 5.5 | 1.95 | 3.5 | 3.05 | 2.55 | 2.45 | 3.0 |
| 12 | ........ | 5.8 | 4.85 | 5.4 | 1.9 | 4.0 | 2.9 | 2.55 | 2.45 | 3.0 |
| 13 | ........ | 5.55 | 4.8 | 5.3 | 1.8 | 3.85 | 2.7 | 2.55 | 2.45 | 3.2 |
| 14 | ........ | 5.55 | 5.1 | 5.1 | 1.7 | 3.55 | 2.7 | 2.55 | 2.45 | 3.2 |
| 15 | ........ | 5.6 | 5.1 | 4.9 | 1.6 | 3.4 | 2.65 | 2.55 | 2.45 | 3.2 |
| 16 | ........ | 5.5 | 5.1 | 4.7 | 1.5 | 3.3 | 2.65 | 2.55 | 2.45 | 3.1 |
| 17 | ........ | 5.2 | 5.2 | 4.6 | 1.55 | 3.0 | 2.6 | 2.55 | 2.45 | 3.15 |
| 18 | ........ | 5.2 | 5.25 | 4.25 | 1.6 | 2.8 | 3.75 | 2.55 | 2.45 | 3.1 |
| 19 | ........ | 5.35 | 5.2 | 4.1 | 1.65 | 2.65 | 2.75 | 2.55 | 2.45 | 3.1 |
| 20 | ........ | 5.5 | 5.8 | 4.0 | 1.65 | 2.55 | 2.65 | 2.55 | 2.45 | 3.1 |
| 21 | ........ | 5.0 | 6.1 | 3.9 | 1.7 | 2.5 | 2.65 | 2.55 | 2.4 | 3.05 |
| 22 | 5.8 | 4.8 | 5.9 | 3.9 | 6.2 | 2.45 | 2.6 | 2.55 | 2.4 | 3.05 |
| 23 | 5.25 | 4.9 | 9.0 | 3.85 | 4.8 | 2.4 | 2.6 | 2.55 | 3.4 | 3.1 |
| 24 | 5.1 | 8.06 | 5.9 | 3.75 | 4.0 | 2.35 | 2.6 | 3.1 | 3.1 | ........ |
| 25 | 4.7 | 7.96 | 5.6 | 3.7 | 3.1 | 12.9 | 2.6 | 2.8 | 3.0 | ........ |
| 26 | 4.5 | 9.72 | 5.45 | 3.6 | 3.2 | 5.5 | 3.8 | 2.65 | 2.7 | ........ |
| 27 | 4.45 | 11.01 | 5.4 | 3.4 | 2.9 | 4.2 | 3.1 | 2.55 | 2.5 | ........ |
| 28 | 4.4 | 10.35 | 5.3 | 3.15 | 2.6 | 4.0 | 2.9 | 2.5 | 2.5 | ........ |
| 29 | 4.15 | 8.6 | 5.25 | 2.95 | 2.4 | 3.8 | 2.8 | 2.5 | 2.5 | ........ |
| 30 | 4.0 | 7.7 | 5.25 | 2.85 | 3.2 | 4.5 | 2.75 | 2.45 | 2.8 | ........ |
| 31 | 3.8 | ........ | 5.3 | ........ | 5.3 | 4.0 | ........ | 2.45 | ........ | 3.2 |

*Station rating table for Purgatory River near Alfalfa, Colo., from March 22 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 0 | 3.10 | 37 | 4.70 | 228 | 7.60 | 1,250 |
| 1.60 | 1 | 3.20 | 45 | 4.80 | 244 | 7.80 | 1,360 |
| 1.70 | 1 | 3.30 | 53 | 4.90 | 261 | 8.00 | 1,480 |
| 1.80 | 1 | 3.40 | 62 | 5.00 | 280 | 8.20 | 1,600 |
| 1.90 | 2 | 3.50 | 72 | 5.20 | 322 | 8.40 | 1,730 |
| 2.00 | 2 | 3.60 | 82 | 5.40 | 369 | 8.60 | 1,860 |
| 2.10 | 3 | 3.70 | 93 | 5.60 | 421 | 8.80 | 2,000 |
| 2.20 | 4 | 3.80 | 105 | 5.80 | 479 | 9.00 | 2,140 |
| 2.30 | 5 | 3.90 | 117 | 6.00 | 545 | 9.50 | 2,505 |
| 2.40 | 6 | 4.00 | 130 | 6.20 | 618 | 10.00 | 2,900 |
| 2.50 | 8 | 4.10 | 143 | 6.40 | 695 | 10.50 | 3,330 |
| 2.60 | 11 | 4.20 | 156 | 6.60 | 778 | 11.00 | 3,780 |
| 2.70 | 15 | 4.30 | 170 | 6.80 | 865 | 11.50 | 4,250 |
| 2.80 | 19 | 4.40 | 184 | 7.00 | 955 | 12.00 | 4,730 |
| 2.90 | 24 | 4.50 | 198 | 7.20 | 1,045 | 12.50 | 5,230 |
| 3.00 | 30 | 4.60 | 213 | 7.40 | 1,145 | | |

The above table is applicable only for open-channel conditions. It is based on 18 discharge measurements made during 1905. It is well defined between gage heights 2.5 feet and 7 feet. Below 2.5 feet the table is very uncertain.

*Estimated monthly discharge of Purgatory River near Alfalfa, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 22 to 31 | 479 | 105 | 230 | 4,562 |
| April | 3,789 | 244 | 911 | 54,210 |
| May | 2,140 | 244 | 502 | 30,870 |
| June | 545 | 22 | 248 | 14,760 |
| July | 618 | 0 | 50.9 | 3,130 |
| August | 5,630 | 6 | 29.3 | 18,020 |
| September | 300 | 11 | 54.6 | 3,249 |
| October | 37 | 7 | 11.3 | 695 |
| November | 62 | 6 | 11.3 | 672 |
| December 1-23, 31 | 45 | 17 | 32.3 | 1,538 |
| The period | | | | 131,700 |

## CIMARRON RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Cimarron River rises in the Raton Mountain Range in Colfax County, N. Mex., at an elevation of nearly 7,000 feet, and flows eastward across Beaver County, in Oklahoma, then across the southwest corner of Kansas, entering Oklahoma again in Woodward County, and following a southeasterly course to its junction with Arkansas River at the Indian Territory line. The basin lies between those of Arkansas and North Canadian rivers, and is within the arid belt. From west to east it is 190 miles from the source to the gaging station at Arkalon, Kans., and 450 miles to its mouth, its extreme width is not more than 50 miles. The area of the basin is 5,200 square miles. The elevation at Arkalon is 2,615 feet; most of the difference of elevation from the source of the river occurs in New Mexico.

The upper course of the Cimarron is entirely in a mountainous and hilly region, very precipitous, rocky, and impervious. In this portion there are no tributaries of any size, and the river seldom receives much water from melting snows. As it approaches Kansas the bottoms are sandy and porous, and, while the adjacent land is hilly, the soil is generally a black loam covered with buffalo grass. There is considerable timber along all the streams in New Mexico and northwestern Oklahoma, but very little in Kansas. The rainfall is very light, being about 12 inches in New Mexico and Oklahoma and increasing to 20 inches at Arkalon. Floods are rare and have no regular periods of occurrence. There are no lakes or marshes in this drainage basin, except small areas here and there along the river bottoms. The land is but little cultivated, forage being the principal product. There are few springs along Cimarron River below the Kansas line and underground water is at depths of from 50 to 150 feet. Some irrigation is practiced by private parties in New Mexico and Oklahoma, but none in Kansas. There is no water for power development in this basin.

### CIMARRON RIVER NEAR KENTON, OKLA.

This station was established April 5, 1904, by W. G. Russell, and was discontinued July 31, 1905. It was located at the highway crossing on the main road, one-half mile north of Kenton, Okla.

The channel is very narrow and crooked, and the current is sluggish. Both banks are low, wooded, and subject to overflow. The bed of the stream is muddy, but too narrow to shift much. There is only one channel at low or medium stages, but there may be two at high stages.

Discharge measurements are made at low water by wading near the gage. At high stages discharges must be computed from the cross section and slope. The initial point for soundings is on the right bank of the stream.

There are two gages. The first is a staff driven vertically into the bed of the stream and fastened to posts driven into the ground. The second gage is in two sections, the first being the same as gage No. 1 and located 70 feet southwest of it. The second section is fastened to a cedar post 100 feet east of the first gage. During 1905 the gage was read by L. A. Wikoff. The bench mark is the top of three nails driven into the west side of an 18-inch willow tree standing 100 feet southwest of the first gage; elevation 8.15 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 147-148, 181.

*Discharge measurements of Cimarron River near Kenton, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 10 | J. M. Giles | 18 | 52 | 0.95 | 1.10 | 49 |
| June 11 | do | 18 | 46 | .59 | .80 | 27 |
| June 11 | do | 18 | 47 | .65 | .90 | 31 |
| June 12 | do | 18 | 45 | .53 | .70 | 24 |

*Daily gage height, in feet, of Cimarron River near Kenton, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | 0.8 | 0.8 | 0.9 | 2.4 | 1.4 | 0.9 | 2.6 |
| 2 | .9 | .8 | .8 | 1.9 | 1.2 | 1.5 | .3 |
| 3 | .9 | .8 | .8 | 1.1 | 1.0 | .9 | .2 |
| 4 | .9 | .8 | .8 | 1.0 | .9 | .7 | .1 |
| 5 | .9 | .8 | .8 | .8 | .8 | .4 | .0 |
| 6 | .9 | .8 | .9 | .8 | .8 | .4 | .0 |
| 7 | .9 | .8 | .9 | .8 | .8 | .5 | .0 |
| 8 | .9 | .8 | .9 | .8 | .7 | 4.5 | .1 |
| 9 | .8 | .8 | .7 | 1.4 | .7 | 1.1 | .1 |
| 10 | .8 | .8 | .7 | 1.6 | .7 | 1.1 | .1 |
| 11 | .8 | .8 | .7 | 1.4 | .7 | .8 | .1 |
| 12 | .9 | .8 | .7 | 1.1 | .7 | .7 | .1 |
| 13 | .9 | .8 | .7 | 1.0 | .7 | .7 | .1 |
| 14 | .9 | .8 | .7 | .9 | .6 | .7 | .0 |
| 15 | .9 | .8 | .7 | .9 | .6 | .7 | .1 |
| 16 | .8 | .8 | .8 | .8 | .6 | .6 | .1 |
| 17 | .9 | .8 | .8 | .8 | .5 | .5 | .0 |
| 18 | .9 | .5 | .7 | .8 | .7 | .5 | .0 |
| 19 | .9 | .6 | .7 | .8 | .5 | .5 | .0 |
| 20 | 1.0 | .8 | .7 | .8 | .5 | .4 | .0 |
| 21 | .9 | .8 | .7 | .8 | 2.1 | .4 | .0 |
| 22 | .9 | .8 | .7 | .8 | .9 | .3 | 2.6 |
| 23 | .8 | .8 | .7 | 1.6 | 4.8 | .2 | 1.1 |
| 23 | .8 | .8 | .7 | 5.8 | 1.1 | .2 | .3 |
| 25 | .8 | .8 | .7 | 4.8 | 1.1 | .1 | .1 |
| 26 | .9 | .7 | .7 | 1.4 | 2.9 | .1 | .0 |
| 27 | .9 | .9 | .7 | 3.4 | 4.3 | .0 | .0 |
| 28 | .8 | .9 | .7 | 3.5 | 2.3 | .0 | .4 |
| 29 | .8 | ....... | .7 | 2.3 | 1.4 | .0 | .0 |
| 30 | .8 | ....... | .7 | 1.7 | ....... | .1 | .0 |
| 31 | .8 | ....... | .7 | ....... | .9 | ....... | .0 |

## CIMARRON RIVER NEAR GARRETT, OKLA.

This station was established May 8, 1905. It is located at Strong's ranch, about 3 miles west of Garrett, Okla., 20 miles east of Kenton, and 50 miles by stage from Clayton, N. Mex., the nearest railroad station. The station is below the mouth of North Carriso and South Carriso creeks and 1 mile below the site of the proposed dam for a storage reservoir.

The channel is straight for 100 feet above and 300 feet below the gage. The current is swift. Both banks are about 6 feet high and subject to overflow. The bed of the stream is composed of rocks and is permanent. There is but one channel at all stages.

Discharge measurements are made by wading near the gage at low water and from a cable one-half mile below the gage at high water. The initial point for soundings is the post supporting the cable on the right bank.

A vertical staff gage is fastened to a cottonwood tree on the left bank, about one-half mile east of the ranch house. During 1905 the gage was read once each day by R. L. Strong. Bench marks were established as follows: (1) A nail in a cross cut in a sandstone ledge at the foot of the hill south of the river, about 50 feet upstream from the gage; elevation, 16.30 feet. (2) A nail in the root of a cottonwood tree about 25 feet north of the gage; elevation, 7.12 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Cimarron River near Garrett, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 7 | W. W. Schlecht | 24 | 41 | 1.00 | 1.30 | 41 |
| June 12 | J. M. Giles | 24 | 28 | 2.39 | 1.52 | 68 |
| June 12 | do | 24 | 32 | 2.08 | 1.50 | 67 |
| June 13 | do | 23 | 34 | 1.58 | 1.40 | 53 |
| June 13 | do | 23 | 33 | 1.59 | 1.40 | 52 |
| June 14 | do | 24 | 40 | 1.98 | 1.69 | 80 |
| June 14 | do | 24 | 42 | 2.17 | 1.79 | 91 |
| August 17 | do | 14 | 12.5 | 1.80 | .90 | 22 |
| August 18 | do | 14 | 12 | 1.38 | .80 | 17 |
| September 26 | E. Patterson | | 8 | 1.46 | .75 | 11.7 |
| September 27 | do | | 8.5 | 1.15 | .73 | 10.7 |
| September 28 | do | | 8.1 | 1.20 | .71 | 9.7 |
| November 14 | do | | 11 | 1.47 | .85 | 16 |
| (a) | J. M. Giles | | 8.1 | 3.68 | 3.50 | 298 |
| (a) | do | | 19.7 | 5.49 | 6.50 | 1,082 |

a Computed from slope measurement, using Kutter's formula.

*Daily gage height, in feet, of Cimarron River near Garrett, Okla., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 1.55 | 0.8 | 0.6 | 0.55 | 0.6 | 0.8 | 0.9 |
| 2 | | 2.65 | 2.25 | 6.1 | .55 | .65 | .8 | .9 |
| 3 | | 1.6 | .95 | 4.3 | .5 | .65 | .85 | .9 |
| 4 | | 1.45 | .8 | 1.8 | 1.1 | .65 | .9 | .85 |
| 5 | | 1.25 | .8 | 1.4 | .75 | .65 | .8 | .85 |
| 6 | | 1.2 | .75 | .95 | 2.5 | .65 | .8 | .85 |
| 7 | 1.3 | 1.15 | .75 | 6.5 | 1.55 | .65 | .8 | .85 |
| 8 | 1.3 | 9.3 | 1.95 | 4.55 | 3.95 | .65 | .85 | .85 |
| 9 | 1.2 | 2.8 | 1.0 | 1.55 | 4.6 | .65 | .85 | .85 |
| 10 | 1.15 | 2.1 | .8 | 1.2 | 5.3 | .65 | .85 | .85 |
| 11 | 1.1 | 1.8 | .7 | .95 | 2.0 | .65 | .85 | .65 |
| 12 | 1.1 | 1.5 | .65 | 1.0 | 1.3 | .65 | 85 | .65 |
| 13 | 1.05 | 1.4 | .65 | 3.3 | 1.0 | .7 | .85 | .65 |
| 14 | 1.05 | 1.5 | .65 | 1.4 | .9 | .7 | .85 | .65 |
| 15 | 1.1 | 1.35 | .6 | 1.1 | .9 | .7 | .85 | .65 |
| 16 | 1.1 | 1.15 | .8 | 1.0 | .85 | .7 | .85 | .7 |
| 17 | 1.1 | 1.2 | .8 | .9 | .85 | .7 | .85 | .85 |
| 18 | 1.05 | 1.1 | .6 | .85 | .85 | .7 | .85 | .9 |
| 19 | 1.0 | 1.05 | .55 | .8 | .85 | .7 | .85 | .9 |
| 20 | 1.0 | 1.0 | .5 | .8 | .8 | .75 | .85 | .9 |
| 21 | 1.05 | 1.0 | .55 | .95 | .8 | .75 | .85 | .9 |
| 22 | 4.45 | .9 | .7 | .75 | .75 | .75 | .95 | .85 |
| 23 | 10.35 | .9 | 2.0 | .7 | .75 | .75 | 1.5 | .85 |
| 24 | 3.4 | .85 | 1.0 | .65 | .75 | .75 | 1.3 | .8 |
| 25 | 1.95 | .85 | .85 | .6 | .7 | .8 | 1.0 | .8 |
| 26 | 2.55 | .8 | .8 | .6 | .8 | .8 | 1.0 | .85 |
| 27 | 7.8 | .8 | .65 | .6 | .7 | .8 | .95 | .9 |
| 28 | 3.42 | .8 | 1.0 | .55 | .7 | .8 | .9 | .9 |
| 29 | 2.55 | .8 | .9 | .55 | .65 | .8 | .9 | .9 |
| 30 | 1.75 | 1 1 | .7 | .55 | .65 | .8 | .9 | .85 |
| 31 | 1.6 | | .65 | .55 | | .8 | | .85 |

*Station rating table for Cimarron River near Garrett, Okla., from May 7 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.70 | 10 | 1.80 | 87 | 2.90 | 205 | 4.00 | 385 |
| 0.80 | 14 | 1.90 | 96 | 3.00 | 220 | 4.20 | 422 |
| 0.90 | 19 | 2.00 | 105 | 3.10 | 235 | 4.40 | 461 |
| 1.00 | 25 | 2.10 | 114 | 3.20 | 251 | 4.60 | 503 |
| 1.10 | 31 | 2.20 | 124 | 3.30 | 267 | 4.80 | 548 |
| 1.20 | 38 | 2.30 | 134 | 3.40 | 283 | 5.00 | 595 |
| 1.30 | 46 | 2.40 | 144 | 3.50 | 299 | 5.20 | 646 |
| 1.40 | 54 | 2.50 | 155 | 3.60 | 316 | 5.40 | 701 |
| 1.50 | 62 | 2.60 | 166 | 3.70 | 333 | 5.60 | 760 |
| 1.60 | 70 | 2.70 | 178 | 3.80 | 350 | 5.80 | 823 |
| 1.70 | 78 | 2.80 | 191 | 3.90 | 367 | 6.00 | 890 |

The above table is applicable only for open-channel conditions. It is based on fifteen discharge measurements made during 1905. It is well defined between gage heights 0.7 foot and 1.8 feet. Above 1.8 feet the table is based on computations from two slope measurements, using Kutter's formula. This extension can be considered only roughly approximate.

*Estimated monthly discharge of Cimarron River near Garrett, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May (23 days) | ............ | 25 | 91.0 | 4,152 |
| June (29 days) | ............ | 14 | 49.6 | 2,853 |
| July | 129 | 5 | 22.2 | 1,365 |
| August (30 days) | ............ | 6 | 90.5 | 5,385 |
| September | 673 | 5 | 74.4 | 4,427 |
| October | 14 | 7 | 10.4 | 640 |
| November | 62 | 14 | 19.5 | 1,160 |
| December | 19 | 8 | 15.4 | 947 |
| The period | ............ | ............ | .......... | 20,930 |

NOTE.—On the days missing the discharge was above the limit of the rating table.

## CIMARRON RIVER AT ARKALON, KANS.

This station was established August 15, 1903, by W. G. Russell, and was discontinued October 31, 1905. It is located at the Chicago, Rock Island and Pacific Railway bridge, about one-half mile north of Arkalon, Kans.

The channel is straight for about 100 feet above and below the station. The current is sluggish at low and swift at high stages. Both banks are low and liable to overflow. The railroad embankment is high at each end of the bridge, forcing the water to pass beneath the bridge at all stages. There is but one channel, which is shallow except at high water. The piles of the bridge and drift may at times affect the measurements.

Discharge measurements are made from the bridge, but can be made at low water by wading. The initial point for soundings is the end of the bridge at the right bank of the river.

The original gage is a staff fastened to the fifth pile bent from the south end of the bridge, on the downstream side. Sand having collected at the foot of the gage April 17, 1905, a section reading from zero to 2 feet was fastened to the fourth bent on the downstream side. During 1905 the gage was read once each day by Miss Ethel Singer. Bench marks were established as follows: (1) The top of the cap at the east end of the second bent from the south end of the bridge; elevation, 15.76 feet. (2) The top of two nails in the top of a pile about 5 feet from the southwest corner of the bridge, 6.5 feet from the west side of the rail; elevation, 17.22 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Papers):

**Description:** Ann 18, iv, p 243; Bull 140, p 167; WS 99, p 247; 131, pp 148-149.
**Discharge:** Ann 18, iv, p 243; Bull 140, p 167; WS 99, p 247; 131, p 149.
**Discharge, monthly:** Ann 18, iv, p 244; Bull 140, p 167.
**Gage heights:** Bull 140, p 167; WS 11, p 64; 99, p 227; 131, p 149
**Rating table:** Ann 18, iv, p 244.

*Discharge measurements of Cimarron River at Arkalon, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 17 | W. G. Russell | 39 | 25 | 1.40 | 1.60 | 35 |
| August 2 | do | 28 | 16 | 1.37 | 1.30 | 22 |

*Daily gage height, in feet, of Cimarron River at Arkalon, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 1.6 | 1.3 | 1.7 | 1.9 | 4.0 | 1.4 | 1.5 | 1.3 | 1.3 |
| 2 | 1.3 | 1.7 | 1.3 | 1.5 | 1.9 | 3.8 | 1.4 | 1.3 | 1.3 | 1.3 |
| 3 | 1.3 | 1.8 | 1.3 | 1.9 | 1.9 | 3.0 | 1.4 | 1.3 | 1.3 | 1.3 |
| 4 | 1.3 | 1.9 | 1.3 | 1.9 | 1.9 | 2.6 | 1.4 | 1.3 | 1.5 | 1.3 |
| 5 | 1.3 | 1.9 | 1.4 | 1.9 | 1.9 | 2.0 | 1.4 | 1.3 | 1.4 | 1.3 |
| 6 | 1.3 | 1.9 | 1.4 | 1.9 | 1.9 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 |
| 7 | 1.3 | 1.9 | 1.4 | 1.8 | 1.9 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 8 | 1.3 | 1.9 | 1.4 | 1.8 | 1.9 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 9 | 1.3 | 1.9 | 1.4 | 1.8 | 1.8 | 1.4 | 1.4 | 2.5 | 1.3 | 1.3 |
| 10 | 1.3 | 1.9 | 1.4 | 1.8 | 1.8 | 4.6 | 1.4 | 2.7 | 1.6 | 1.3 |
| 11 | 1.3 | 1.9 | 1.4 | 2.0 | 1.8 | 2.9 | 1.4 | 2.3 | 1.4 | 1.3 |
| 12 | 1.3 | 1.9 | 1.4 | 1.8 | 1.8 | 2.6 | 1.4 | 1.7 | 1.3 | 1.3 |
| 13 | 1.3 | 1.9 | 1.4 | 1.8 | 1.8 | 2.3 | 1.4 | 1.3 | 1.7 | 1.3 |
| 14 | 1.3 | 1.2 | 1.4 | 1.7 | 1.8 | 2.0 | 1.4 | 1.3 | 1.4 | 1.3 |
| 15 | 1.3 | 1.2 | 1.4 | 1.6 | 1.7 | 1.9 | 1.4 | 1.3 | 1.3 | 1.3 |
| 16 | 1.3 | 1.3 | 1.4 | 1.5 | 1.7 | 1.6 | 1.4 | 1.3 | 1.7 | 1.3 |
| 17 | 1.3 | 1.3 | 1.4 | 1.6 | 1.5 | 1.4 | 1.4 | 1.3 | 1.4 | 1.3 |
| 18 | 1.3 | 1.3 | 1.4 | 1.6 | 1.4 | 1.4 | 1.5 | 1.3 | 1.3 | 1.3 |
| 19 | 1.3 | 1.3 | 1.4 | 1.5 | 1.4 | 1.4 | 1.5 | 1.3 | 1.3 | 1.3 |
| 20 | 1.3 | 1.3 | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 21 | 1.3 | 1.6 | 1.4 | 1.5 | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 22 | 1.3 | 2.1 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 23 | 1.3 | 1.9 | 1.4 | 1.8 | 1.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 24 | 1.3 | 1.7 | 1.4 | 2.5 | 3.7 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 25 | 1.3 | 1.4 | 1.4 | 2.8 | 3.8 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 26 | 1.3 | 1.4 | 1.4 | 3.4 | 3.5 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 27 | 1.3 | 1.3 | 1.4 | 4.6 | 3.4 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 28 | 1.3 | 1.3 | 1.4 | 3.0 | 3.6 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 29 | 1.3 | ........ | 1.4 | 1.9 | 4.2 | 1.4 | 1.4 | 1.3 | 1.3 | 1.3 |
| 30 | 1.4 | ........ | 1.4 | 1.9 | 4.7 | 1.4 | 1.5 | 1.3 | 1.3 | 1.3 |
| 31 | 1.5 | ........ | 1.4 | ........ | 4.5 | ........ | 1.5 | 1.3 | ........ | 1.3 |

## CIMARRON RIVER NEAR WAYNOKA, OKLA.

This station was established September 11, 1903, by W. G. Russell, and was discontinued December 31, 1905. It is located at the railway bridge 2½ miles southwest of Waynoka, Okla.

The channel is straight for 1,000 feet above and below the station. Both banks are liable to overflow at very high water. The bed is shifting quicksand. At low water there may be several channels. At high water there is one channel, broken by the bridge supports.

Discharge measurements are made from the railway bridge, which is supported on piles and has a total span of 2,158 feet, and by wading at low water. The initial point for soundings is the east end of the bridge.

The gage is a staff fastened to the east side of the eighth pile bent from the east end of the bridge. During 1905 the gage was read by M. J. Sunden. Bench marks were established as follows: (1) The top of the cap of the bench to which the gage is spiked; elevation 10.93 feet. (2) The northeast corner of the cap of the bent at the fill at the east end of the bridge on the downstream side; elevation, 10.09 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 246; 131, p 150.
Discharge: 131, p 150.
Gage heights: 99, p 246; 131, p 151.

*Discharge measurements of Cimarron River near Waynoka, Okla., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| May 1 | W. G. Russell | 1.90 | 905 |
| June 7 | J. M. Giles | .90 | 68 |
| June 20 | Earl Patterson | .95 | 99 |
| June 21 | do | 1.40 | 318 |
| July 20 | do | .40 | .2 |
| August 18 | do | 1.10 | 93 |
| August 28 | do | .30 | 2.6 |
| September 20 | do | .90 | 40 |
| October 21 | J. M. Giles | .30 | .2 |
| October 26 | Earl Patterson | .41 | .4 |
| November 26 | do | 1.50 | 258 |
| December 19 | do | 1.05 | 75 |

*Daily gage height, in feet, of Cimarron River near Waynoka, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 1.3 | 1.5 | 1.0 | 1.9 | 1.6 | 0.8 | 1.6 | 0.3 | 0.5 | 0.5 | 1.0 |
| 2 | 1.1 | 1.3 | 1.4 | 1.0 | 1.8 | 1.5 | 2.4 | 1.5 | .3 | .5 | .5 | 1.0 |
| 3 | 1.2 | 1.3 | 1.4 | 1.0 | 1.7 | 1.5 | 3.0 | 1.0 | .3 | .5 | .5 | 1.0 |
| 4 | 1.2 | 1.3 | 1.3 | 1.0 | 1.6 | 1.3 | 3.0 | .8 | .3 | .5 | .5 | 1.0 |
| 5 | 1.2 | 1.3 | 1.3 | 1.5 | 1.5 | 1.0 | 2.0 | .6 | .3 | .5 | .6 | 1.0 |
| 6 | 1.2 | 1.3 | 1.3 | 1.5 | 1.5 | .9 | 1.8 | .5 | .3 | .5 | .6 | 1.0 |
| 7 | 1.2 | 1.3 | 1.3 | 1.5 | 1.5 | .8 | 1.6 | .5 | .3 | .5 | 1.0 | 1.0 |
| 8 | 1.1 | 1.3 | 1.3 | 1.5 | 1.5 | .8 | 1.3 | .5 | .6 | .4 | 1.0 | 1.0 |
| 9 | 1.1 | 1.3 | 2.0 | 1.5 | 1.4 | .7 | 2.0 | .5 | .6 | .4 | 1.0 | 1.0 |
| 10 | 1.1 | 1.3 | 2.0 | 1.5 | 1.3 | .7 | 1.8 | .5 | 4.5 | .4 | 1.0 | 1.0 |
| 11 | 1.0 | 1.3 | 2.0 | 1.4 | 1.2 | .6 | 1.5 | .5 | 2.5 | .4 | 1.0 | 1.0 |
| 12 | 1.0 | 1.3 | 2.0 | 1.4 | 1.1 | .5 | 1.2 | .5 | 2.0 | .4 | 1.0 | 1.0 |
| 13 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | .5 | 1.0 | 2.4 | 1.8 | .4 | 1.0 | 1.0 |
| 14 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | .6 | .8 | 2.0 | 1.5 | .4 | 1.0 | 1.0 |
| 15 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | .7 | .5 | 1.9 | 1.3 | .4 | .9 | 1.0 |
| 16 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | 1.0 | .3 | 1.5 | 1.0 | .4 | .9 | 1.0 |
| 17 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | 1.0 | .4 | 1.2 | 1.0 | .4 | .9 | 1.0 |
| 18 | 1.0 | 1.3 | 2.0 | 1.3 | 1.0 | 1.0 | .4 | 1.0 | 1.0 | .3 | .9 | 1.0 |
| 19 | 1.1 | 1.3 | 2.0 | 1.6 | 1.0 | 1.0 | .4 | 1.0 | .9 | .3 | .9 | 1.0 |
| 20 | 1.2 | 1.3 | 1.8 | 1.6 | 1.0 | 1.0 | .4 | 1.5 | .8 | .3 | 1.0 | 1.0 |
| 21 | 1.3 | 1.3 | 1.6 | 1.5 | 1.0 | 1.2 | .4 | 1.3 | .7 | .3 | 1.0 | 1.0 |
| 22 | 1.3 | 1.4 | 1.5 | 1.5 | 1.0 | 1.3 | 2.3 | 1.2 | .6 | .3 | 1.0 | 1.0 |
| 23 | 1.3 | 1.5 | 1.5 | 1.5 | 1.0 | 1.4 | 2.0 | 1.0 | .6 | .3 | 1.0 | 1.0 |
| 24 | 1.3 | 1.9 | 1.4 | 1.5 | 1.0 | 1.5 | 1.8 | .8 | .6 | .4 | 2.0 | 1.0 |
| 25 | 1.3 | 1.9 | 1.4 | 2.2 | 1.0 | 1.0 | 1.6 | .6 | .6 | .4 | 1.2 | 1.0 |
| 26 | 1.3 | 1.6 | 1.4 | 2.2 | 2.0 | 1.4 | 1.5 | .5 | .6 | .4 | 1.2 | 1.0 |
| 27 | 1.3 | 1.5 | 1.3 | 2.2 | 2.0 | 1.3 | 1.4 | .5 | .6 | .4 | 1.2 | 1.0 |
| 28 | 1.3 | 1.5 | 1.2 | 2.0 | 2.0 | 1.2 | 2.5 | .5 | .6 | .4 | 1.2 | 1.0 |
| 29 | 1.3 | ....... | 1.1 | 2.0 | 2.0 | 1.0 | 2.0 | .5 | .6 | .4 | 1.1 | 1.0 |
| 30 | 1.3 | ....... | 1.0 | 1.9 | 2.0 | .9 | 2.0 | .4 | .6 | .4 | 1.1 | 1.0 |
| 31 | 1.3 | ....... | 1.0 | ....... | 1.8 | ....... | 1.8 | .4 | ....... | .4 | ....... | 1.0 |

## VERDIGRIS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

This drainage basin lies between those of Grand and Arkansas rivers, being entirely within the humid belt. It has no mountain tributaries, but depends for its water supply on the precipitation within its area. Its catchment area extends east and west in Kansas and Indian Territory a distance of 70 miles, and north and south 170 miles, giving it an area of 7,920 square miles at the gaging station at Catoosa, Ind. T. The main stream is formed by springs and small tributaries in Chase County, Kans., about 100 miles east of the center of the State, at an elevation of 1,075 feet, and flows nearly due south into Arkansas River just above its junction with Grand River, about 6 miles northeast of Muscogee. Its elevation at the mouth is 513 feet above sea level. Its principal tributaries are Fall, Elk, and Caney rivers, all of which enter from the west. Fall and Elk rivers drain southern Kansas, and Caney River drains southern Kansas and part of Indian Territory.

This basin lies within the Coal Measures and is composed of porous and broken sandstones and limestones, which are covered with a black, porous loam. This, with a precipitation of 35 and 40 inches, gives large quantities of underground water at a medium depth. There are large belts of timber along this river and all its tributaries, increasing in size to the south, where the forest covers all the bottom lands and a large part of the upland. The cultivated area in Kansas is about 59 per cent of the drainage area; in Indian Territory it is much less. The general slope of the basin is small and the streams are very crooked, with much débris in the channels, causing a very low velocity. Any heavy rainfall of long duration gives a flood which covers all the low bottom lands. The bottom lands in Kansas are generally cultivated and suffer damage, but those in Indian Territory are not generally under cultivation, and the damage is not great. The extreme flood height at the gaging station at Catoosa, Ind. T., was 48.8 feet and at Independence, Kans., 36 feet. These floods are liable to occur at any time during spring, summer, or fall. A few small lakes or ponds lie along the lower course of Verdigris River, but they are not of great extent. There are no irrigation works, and only a few water-power sites for mills, and most of these are abandoned. Along the middle course of the Verdigris are many large gas and oil wells, this portion of the basin being in the gas and oil belt of Kansas.

### VERDIGRIS RIVER NEAR INDEPENDENCE, KANS.

This station was established April 20, 1904, by M. C. Hinderlider, for the purpose of making flood observations. It is located at the highway bridge three-fourths of a mile northwest of Independence, Kans.

The channel is straight for one-fourth mile above and below the station. The current is swift. Both banks are high rock cliffs covered with trees. The left bank overflows during floods. The bed of the stream is composed of gravel and bed rock, and is permanent. There is but one channel, divided at higher stages by one stone pier.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is the south face of the north abutment.

A standard chain is attached to the upstream guard rail near the south end of the bridge. There were no gage heights during 1905. Bench marks were established as follows: (1) The top of the capstone on the upstream side of the main pier in the stream, marked "+U. S. B. M. No. 1;" elevation, 44.11 feet. (2) The top stone of the north abutment at the end of the bridge on the upstream side, marked "U. S. B. M. No. 2;" elevation, 42.69 feet. (3) The top of the stone step in the upstream wing of the north abutment, marked "U.S.B. M.No.3;" elevation,38.00 feet. (4 )The topof the stone in the upstream wing wall of the south abutment, marked "+U. S. B. M. No. 4;" elevation, 45.17 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 151-152.

*Discharge measurements of Verdigris River near Independence, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 16 | W. G. Russell | 134 | 689 | 3.71 | 7.35 | 2,555 |
| June 16 | do | 137 | 765 | 3.67 | 7.80 | 2,809 |
| July 26 | do | 45 | 84 | 1.56 | 2.40 | 131 |
| August 22 | do | 97 | 276 | 3.16 | 4.20 | 872 |
| September 28 | do | 98 | 263 | 3.36 | 3.90 | 884 |

### VERDIGRIS RIVER NEAR CATOOSA, IND. T.

This station was established September 25, 1903, by W. G. Russell. It is located at the Frisco Railway bridge, 2 miles northeast of Catoosa, Ind. T.

The channel is straight for 200 feet above and below the bridge. The current is sluggish. Both banks are low, wooded, and subject to overflow, but all water passes beneath the bridge and its approaches. At low water there is one channel, and at high water the channel is broken by the stone piers in the pile supports of the bridge, making five channels. The gaging section is obstructed by broken piles, on which drift collects. During high water it is impossible to get any but surface velocities, and much of the current out of the main channel has a very low velocity.

Discharge measurements are made from the single-span steel railway bridge and its approaches. The initial point for soundings is at the west end of the bridge, 338 feet from the zero of the gage scale.

A standard chain gage is attached to the guard rail of the railway bridge. During 1905 the gage was read by John L. Calloway. The bench mark is the top of the second stone pier from the west and upstream side of the bridge; elevation, 50.21 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 260; 131, p 153.
Discharge: 131, p 153.
Gage heights: 99, p 261; 131, p 154.

*Discharge measurements of Verdigris River near Catoosa, Ind. T., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 9 | W. G. Russell | 192 | 1,213 | 3.20 | 8.90 | 3,881 |
| May 10 | do | 182 | 871 | 3.06 | 7.05 | 2,670 |
| October 12 | do | 143 | 290 | 1.12 | 3.90 | 326 |

*Daily gage height, in feet, of Verdigris River near Catoosa, Ind. T., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 4.4 | 12.0 | 7.7 | 7.4 | 37.65 | 10.2 | 9.25 | 9.8 | 10.6 | 21.4 | 6.9 |
| 2 | 3.7 | 4.4 | 10.1 | 7.0 | 7.4 | 27.4 | 11.0 | 9.1 | 9.3 | 10.05 | 16.9 | 6.5 |
| 3 | 3.6 | 4.4 | 9.8 | 6.9 | 7.3 | 24.4 | 18.7 | 9.1 | 9.15 | 10.0 | 11.7 | 6.2 |
| 4 | 3.5 | 4.4 | 8.0 | 6.8 | 7.1 | 25.6 | 8.75 | 9.1 | 8.2 | 9.2 | 7.5 | 6.0 |
| 5 | 3.5 | 4.4 | 7.9 | 6.7 | 7.0 | 25.4 | 6.05 | 8.4 | 8.7 | 9.1 | 5.4 | 5.1 |
| 6 | 3.5 | 4.4 | 7.9 | 6.6 | 11.8 | 25.2 | 11.25 | 8.4 | 9.15 | 9.0 | 18.9 | 5.8 |
| 7 | 3.5 | 4.3 | 9.8 | 6.6 | 12.1 | 25.8 | 26.25 | 8.2 | 8.1 | 8.2 | 21.8 | 5.5 |
| 8 | 3.5 | 4.2 | 31.2 | 6.6 | 8.1 | 16.3 | 29.1 | 8.2 | 9.7 | 7.4 | 25.0 | 5.3 |
| 9 | 3.5 | 4.0 | 28.05 | 6.6 | 9.0 | 12.0 | 27.2 | 7.3 | 10.7 | 6.6 | 20.4 | 5.1 |
| 10 | 3.6 | 4.0 | 24.0 | 6.9 | 8.7 | 9.4 | 19.2 | 7.3 | 11.15 | 5.7 | 15.2 | 5.1 |
| 11 | 3.6 | 4.0 | 22.1 | 6.9 | 8.9 | 9.5 | 16.7 | 7.2 | 10.6 | 4.8 | 9.3 | 5.0 |
| 12 | 3.7 | 4.0 | 18.2 | 6.5 | 8.9 | 8.1 | 11.25 | 7.2 | 10.1 | 3.9 | 6.8 | 5.0 |
| 13 | 3.7 | 4.0 | 14.3 | 6.5 | 10.7 | 7.2 | 8.2 | 8.7 | 10.6 | 3.8 | 6.4 | 5.0 |
| 14 | 3.8 | 4.0 | 12.1 | 8.2 | 12.4 | 6.9 | 8.1 | 12.1 | 10.3 | 3.4 | 6.5 | 5.0 |
| 15 | 3.8 | 4.0 | 9.1 | 7.0 | 10.4 | 7.2 | 8.25 | 12.4 | 10.2 | 3.0 | 6.8 | 4.1 |
| 16 | 3.8 | 4.0 | 8.0 | 7.0 | 9.0 | 7.9 | ....... | 9.75 | 10.7 | 2.8 | 6.5 | 4.1 |
| 17 | 3.8 | 4.0 | 8.9 | 7.0 | 8.5 | 9.3 | 13.7 | 7.15 | 10.1 | 2.4 | 5.2 | 4.9 |
| 18 | 3.8 | 3.9 | 9.4 | 7.4 | 8.7 | 9.8 | 19.45 | 7.0 | 10.65 | 18.8 | 4.1 | 4.8 |
| 19 | 3.9 | 3.9 | 32.15 | 7.8 | 8.7 | 10.1 | 20.85 | 6.3 | 10.3 | 15.5 | 4.8 | 4.6 |
| 20 | 3.9 | 4.0 | 36.0 | 7.9 | 13.85 | 12.5 | 21.5 | 10.35 | 11.15 | 14.8 | 5.8 | 4.2 |
| 21 | 3.9 | 4.4 | 27.8 | 7.9 | 11.9 | 12.0 | 20.15 | 20.75 | 10.15 | 7.8 | 5.8 | 4.4 |
| 22 | 4.0 | 4.5 | 15.1 | 7.9 | 11.9 | 9.0 | 18.65 | 26.7 | 10.1 | 6.4 | 5.4 | 4.4 |
| 23 | 4.1 | 5.2 | 10.0 | 7.8 | 10.8 | 8.2 | 19.2 | 28.25 | 10.15 | 5.5 | 5.3 | 4.4 |
| 24 | 4.1 | 8.3 | 6.5 | 7.9 | 10.7 | 7.9 | 17.6 | 22.35 | 11.15 | 4.1 | 5.2 | 4.3 |
| 25 | 4.1 | 18.4 | 6.4 | 7.9 | 10.8 | 7.5 | 16.1 | 18.85 | 11.1 | 7.7 | 5.1 | 4.8 |
| 26 | 4.1 | 29.3 | 6.3 | 7.9 | 10.8 | 7.4 | 16.0 | 16.8 | 10.1 | 25.5 | 3.5 | 4.8 |
| 27 | 4.0 | 24.0 | 6.0 | 8.0 | 11.4 | 7.2 | 15.05 | 14.2 | 10.2 | 18.6 | 7.9 | 4.8 |
| 28 | 4.0 | 14.0 | 6.3 | 7.9 | 20.25 | 7.0 | 27.25 | 14.2 | 10.1 | 15.2 | 8.9 | 4.8 |
| 29 | 4.0 | ....... | 8.6 | 7.8 | 22.9 | 6.8 | 10.5 | 14.2 | 11.45 | 10.3 | 7.6 | 4.8 |
| 30 | 4.3 | ....... | 9.6 | 7.6 | 42.5 | 6.7 | 9.4 | 14.2 | 10.6 | 8.1 | 7.2 | 4.8 |
| 31 | 4.4 | ....... | 9.7 | ....... | 42.5 | ....... | 9.4 | 12.2 | ....... | 10.2 | ....... | 5.3 |

## FALL RIVER AT FALL RIVER, KANS.

This station was established as a flood station, April 22, 1904, by M. C. Hinderlider. It is located at the highway bridge one-eighth mile north of Fall River, Kans.

The channel is straight for about 300 feet above and 500 feet below the station, and the current is sluggish at low stages and swift at high stages. The right bank is of loam, sloping gradually out for about 100 feet to sandstone cliffs from 10 to 15 feet high. The left bank slopes at an angle of about 45° to the height of the bridge floor. Both banks are timbered and do not overflow except at extreme stages. The low ground on the left bank extending outward from the northwest end of the bridge is overflowed at very high stages of the river. The bed of the stream is composed of loam and mud and is probably unstable.

Discharge measurements are made from the three-span bridge to which the gage is attached. The initial point for soundings is the surface of the ground at the north side of the right abutment.

A standard chain gage is fastened to the downstream railing near the left end of the bridge. During 1905 the gage was read once daily, and hourly during dangerous rises in the stream, by Jesse McDaniel. Bench marks were established as follows: (1) The top of the south masonry abutment on the downstream side; elevation, 41.768 feet. (2) On the sandstone ledge at the foot of the northeast corner of the south abutment; elevation, 33.777 feet. (3) The top of the first pier from the right bank, downstream side; elevation, 41.03 feet. (4) The top of the second pier from the right bank, downstream side; elevation, 40.08 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water Supply Paper No. 131, United States Geological Survey, pages 154-155.

*Discharge measurements of Fall River at Fall River, Kans., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 31 | W. G. Russell | 95 | 229 | 0.71 | 3.20 | 164 |
| September 29 | .....do | 92 | 196 | .46 | 2.90 | 91 |

*Daily gage height, in feet, of Fall River at Fall River, Kans., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.2 | 2.0 | 3.2 | 2.4 | 2.4 | 3.1 | 3.8 | 3.0 | 2.0 |
| 2 | 2.1 | 2.0 | 3.0 | 2.4 | 2.4 | 3.6 | 4.0 | 3.0 | 2.0 |
| 3 | 2.1 | 2.0 | 3.0 | 2.9 | 2.4 | 6.8 | 17.5 | 3.0 | 2.0 |
| 4 | 2.0 | 2.0 | 2.8 | 2.6 | 2.4 | 4.0 | 7.5 | 2.9 | 2.0 |
| 5 | 2.0 | 2.0 | 2.6 | 2.6 | 2.4 | 3.6 | 5.75 | 2.8 | 2.0 |
| 6 | 2.0 | 2.0 | 2.4 | 2.4 | 2.4 | 3.6 | 5.4 | 2.7 | 2.0 |
| 7 | 2.0 | 2.0 | 2.4 | 2.4 | 2.4 | 3.6 | 5.0 | 2.6 | 2.0 |
| 8 | 2.0 | 2.0 | 2.3 | 2.4 | 2.4 | 3.5 | 4.7 | 2.5 | 2.0 |
| 9 | 2.0 | 2.0 | 2.3 | 2.4 | 2.4 | 3.5 | 5.6 | 2.5 | 2.0 |
| 10 | 2.0 | 2.0 | 2.3 | 2.4 | 2.4 | 3.2 | 5.0 | 2.5 | 2.0 |
| 11 | 2.0 | 2.0 | 2.2 | 2.4 | 2.4 | 3.2 | 4.6 | 2.4 | 2.0 |
| 12 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 3.2 | 4.1 | 2.4 | 2.0 |
| 13 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 3.2 | 3.75 | 2.4 | 2.0 |
| 14 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 3.0 | 3.6 | 2.3 | 2.4 |
| 15 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 3.0 | 3.6 | 2.3 | 3.0 |
| 16 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 11.3 | 3.6 | 2.3 | 3.0 |
| 17 | 2.0 | 2.0 | 2.1 | 2.4 | 2.4 | 8.0 | 3.55 | 2.3 | 28.0 |
| 18 | 2.0 | 2.0 | 2.8 | 2.3 | 2.4 | 6.0 | 3.6 | 2.3 | 16.0 |
| 19 | 2.0 | 2.0 | 2.6 | 2.3 | 2.4 | 4.0 | 3.5 | 2.2 | 18.25 |
| 20 | 2.0 | 2.0 | 2.4 | 2.3 | 2.4 | 3.6 | 3.5 | 2.2 | 7.1 |
| 21 | 2.0 | 2.8 | 2.4 | 2.3 | 2.4 | 3.6 | 3.5 | 2.2 | 5.25 |
| 22 | 2.0 | 3.6 | 2.8 | 2.3 | 2.4 | 3.6 | 3.5 | 2.2 | 4.25 |
| 23 | 2.0 | 4.6 | 2.6 | 2.8 | 2.4 | 3.6 | 3.4 | 2.1 | 3.7 |
| 24 | 2.0 | 4.0 | 2.4 | 2.8 | 2.4 | 3.6 | 3.3 | 2.1 | 3.4 |
| 25 | 2.0 | 3.5 | 2.4 | 2.6 | 2.4 | 3.6 | 3.2 | 2.0 | 3.8 |
| 26 | 2.0 | 3.5 | 2.4 | 2.4 | 2.4 | 3.6 | 3.2 | 2.0 | 3.1 |
| 27 | 2.0 | 3.2 | 2.3 | 2.4 | 2.6 | 3.5 | 3.0 | 2.0 | 3.0 |
| 28 | 2.0 | 3.0 | 2.2 | 2.4 | 2.8 | 3.5 | 2.9 | 2.0 | 3.0 |
| 29 | 2.0 | ........ | 2.2 | 2.4 | 4.9 | 3.6 | 2.8 | 2.0 | 3.0 |
| 30 | 2.0 | ........ | 2.4 | 2.4 | 6.0 | 3.6 | 3.0 | 2.0 | 3.0 |
| 31 | 2.0 | ........ | 2.4 | ........ | 3.2 | ........ | 3.0 | 2.0 | ........ |

## NEOSHO RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Neosho River rises in central Kansas, flows to the east and southeast, draining eastern and southeastern Kansas, and then flows southward into Arkansas River just below Fort Gibson, Ind. T. Its drainage basin lies between those of Kansas and Osage rivers on the north and east, and of Arkansas and Verdigris rivers on the south and west, being entirely within the humid belt and east of the Great Plains. The drainage basin extends east and west from central Kansas to western Missouri, about 200 miles, and north and south into Indian Territory about the same distance, giving an area of 12,660 square miles. The Neosho has many small tributaries, and flows through a rich agricultural country. It has no mountain tributaries, but depends on the precipitation within its basin for its water supply.

The upper course of Neosho River lies in the Permian and upper Coal Measures, which are shales, clays, and broken limestones, the overlying soil being a loose, porous loam. The land is rather rolling and hilly, except along the streams, which have a large percentage of bottom land. The elevation at the headwaters is about 1,230 feet and at Wyandotte about 758 feet. The precipitation within this part of the basin is 30 to 35 inches per annum. The middle course lies in the upper Coal Measures, except for a short distance in the lower part, where it extends into the lower Coal Measures. In this stretch the formation is principally a broken limestone, overlain by a porous loam. The lower course of the river lies in the lower Coal Measures, most of the rocks being limestones, somewhat broken, with an overlying soil of black porous loam, which permits the water to percolate through into the lower strata. This gives plenty of underground water, and many springs. The Neosho above the mouth of Spring River flows through the large oil and gas belts of Kansas. The precipitation in the middle and lower courses ranges from 35 to more than 40 inches per year. This part of Neosho River is very crooked and has a light slope, and the valley is subject to frequent and destructive floods. In many places dikes have been built to keep out the water, and the railroads have raised their tracks to get above it. There are a few dams on this part of the river for mills and power purposes, but the sites are on the lowlands and give a low fall. There are no power plants on Neosho River below Wyandotte, but one or more are under contemplation. The fall of the Neosho from Wyandotte to Fort Gibson is about 242 feet. In the upper part of this section of the basin the timber is in belts along the streams, while in the lower part it is in large bodies and the sections of prairie land are very scattering. The percentage of cultivated land along Neosho River in Kansas is 60 per cent; along Spring River and the Neosho below Wyandotte it is much less.

Spring River, the main tributary of Neosho River, rises in southwestern Missouri and flows through the lead and zinc regions in a southwest course into Kansas and then southward into Indian Territory. Its entire course is through rolling and broken country, except along the stream bottom. This is a grazing, agricultural, and mining region, the lead and zinc industry along the upper and middle courses of Spring River being very extensive. The soil is rocky, but in places there is considerable porous loam which allows the water to percolate into the lower strata, giving good underground water at a medium depth. The precipitation in the basin of Spring River is at least 40 inches per year; if this falls suddenly and in large quantities the channel of the river is not capable of carrying it off and destructive floods follow. The worst flood for many years occurred in July, 1905. There is a large electric power plant on Spring River at Lowell, Kans., with a fine concrete dam and powerhouse, which furnishes electricity for several cities along this river and in the vicinity. This dam and plant withstood the flood without any material damage.

### NEOSHO RIVER AT FORT GIBSON, IND. T.[a]

This station was established September 22, 1903, by W. G. Russell. It is located at the Missouri Pacific Railway bridge, three-fourths of a mile northwest of Fort Gibson, Ind. T.

The channel is straight for about 500 feet above and below the station. The current is sluggish except at high water, when it is swift near the right bank. The right bank is high and wooded, and overflows only at very high stages. The left bank is high, rocky, and clean, and does not overflow. The bed of the stream is a smooth rock from the left bank to the middle; on the right it is sand and changes with every flood. There are four channels at low and five at high water. Drift at very high water makes it impossible to get other than surface velocities. October 11, 1905, the fall of the river from a point above the gaging station to a point about the same distance below, 620 feet distant, was 0.059 foot, which gives a slope of 0.00009516.

Discharge measurements are made from the downstream side of the three-span steel bridge. The bridge has a total length of 625 feet, with a pile approach of 157 feet at the west end. It is slightly oblique to the course of the current. The initial point for soundings is the edge of the abutment on the left bank of the river.

There are two sections of the gage. The first is a vertical staff fastened to the east face of the first stone pier from the left bank. The 9-foot mark is the top of the steel caisson and below this point gage heights are taken by means of a standard chain gage let down from a nail in the guard rail, along which the scale is marked. This gage is used only in very low or very high water and is kept in the pump house when not in use. During 1905 the gage was read once each day by W. L. Blackwell. Bench marks were established as follows:

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[a] Formerly known as Grand River.

(1) A cross, marked "B. M," on a hard limestone rock in the face of the wall 4 feet above the upstream side of the bridge on the left bank of the river; elevation, 24.90 feet above the datum of the gage. (2) A United States Geological Survey standard bench mark, marked "516," on the top of the east bridge pier; elevation, 516 feet above sea level and 40.94 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 37, p 268; 99, p 257; 131, pp 158–159.
**Discharge**: 37, p 268; 131, p 159.
**Gage heights**: 37, p 268; 99, p 257; 131, p 160.

*Discharge measurements of Neosho River at Fort Gibson, Ind. T., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 7 | W. G. Russell | 495 | 4,227 | 2.01 | 11.40 | 8,484 |
| May 8 | do | 499 | 4,436 | 2.57 | 11.90 | 11,400 |
| June 30 | do | 493 | 3,871 | 1.41 | 11.00 | 5,457 |
| October 11 | do | 468 | 3,135 | .83 | 9.90 | 2,588 |

*Daily gage height, in feet, of Neosho River at Fort Gibson, Ind. T., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.0 | 9.8 | 15.1 | 12.5 | 10.6 | 20.0 | 12.0 | 17.0 | 11.5 | 14.2 | 13.0 | 11.0 |
| 2 | 9.0 | 9.8 | 14.3 | 12.7 | 10.6 | 19.0 | 13.5 | 17.5 | 10.2 | 14.0 | ....... | 10.8 |
| 3 | 9.0 | 9.8 | 13.0 | 14.0 | 10.6 | 17.0 | 13.5 | 17.0 | 10.0 | 14.0 | 16.5 | 10.6 |
| 4 | 9.0 | ....... | 12.0 | 14.7 | 10.5 | 17.0 | 14.0 | 15.0 | 10.0 | 13.8 | 15.5 | 10.5 |
| 5 | 9.0 | ....... | 12.0 | 14.5 | 10.5 | 16.0 | 14.0 | 14.5 | 10.5 | 13.6 | 14.0 | 10.4 |
| 6 | 9.0 | ....... | 12.0 | 14.0 | 10.6 | 15.0 | 17.0 | 14.0 | ....... | 13.5 | 12.5 | 10.4 |
| 7 | 9.0 | ....... | 12.4 | 13.5 | 11.3 | 14.0 | 16.5 | 13.5 | 10.8 | 13.4 | 12.8 | 10.4 |
| 8 | 9.0 | ....... | 12.8 | 13.0 | 11.8 | 19.0 | 16.0 | 13.0 | 11.0 | 13.3 | 13.8 | 10.4 |
| 9 | 9.1 | ....... | 13.8 | 12.5 | 11.9 | 16.0 | 15.5 | 12.8 | 10.8 | 13.2 | 14.8 | 10.4 |
| 10 | 9.2 | ....... | 17.0 | 12.0 | 12.0 | 14.0 | 16.0 | 12.6 | 10.6 | 13.2 | 13.0 | 10.4 |
| 11 | 9.2 | ....... | 17.5 | 12.0 | 11.6 | 13.8 | 15.5 | 12.8 | 11.6 | 13.0 | 12.5 | 10.3 |
| 12 | 9.2 | 8.33 | 15.0 | 12.0 | 11.4 | 13.6 | 15.0 | 12.6 | 11.5 | 12.5 | 12.0 | 10.3 |
| 13 | 9.2 | 8.33 | 14.0 | 12.0 | 11.4 | 13.4 | 14.5 | 12.0 | 12.5 | 12.0 | 11.6 | 10.3 |
| 14 | 9.2 | 8.33 | 14.0 | 12.0 | 13.0 | 13.6 | 14.0 | 11.8 | 14.5 | 11.8 | 11.5 | 10.3 |
| 15 | 9.2 | 8.33 | 13.5 | 11.7 | 12.5 | 13.4 | 13.5 | 11.6 | 12.5 | 11.6 | 11.4 | 10.2 |
| 16 | 9.2 | 8.33 | 13.0 | 11.4 | 12.3 | 13.0 | 13.0 | 11.4 | 12.3 | 11.0 | 11.3 | 10.2 |
| 17 | 9.2 | 8.33 | 12.9 | 11.2 | 13.3 | 12.9 | 12.8 | 12.0 | 12.2 | 10.5 | 11.0 | 10.2 |
| 18 | 9.4 | 8.33 | 13.0 | 11.0 | 13.5 | 12.8 | 12.6 | 12.6 | 14.2 | 10.4 | 11.0 | 10.1 |
| 19 | 9.4 | 9.0 | 15.5 | 11.0 | 13.7 | 13.0 | 12.4 | 12.8 | 15.2 | 13.4 | 10.9 | 10.0 |
| 20 | 9.4 | 9.1 | 18.0 | 11.0 | 12.7 | 12.8 | 12.2 | 18.0 | 16.4 | 14.0 | 10.8 | 10.0 |
| 21 | 9.5 | 9.1 | 18.7 | 11.0 | 18.0 | 12.4 | 12.0 | 23.5 | 16.4 | 14.0 | 10.7 | 9.8 |
| 22 | 9.5 | 9.2 | 16.5 | 11.0 | 17.0 | 14.4 | 14.5 | 20.0 | 16.3 | 13.9 | 10.7 | 9.8 |
| 23 | 9.5 | 9.5 | 15.0 | 10.9 | 17.0 | 14.4 | 16.5 | 18.0 | 15.8 | 13.6 | 10.6 | 9.8 |
| 24 | 9.5 | 9.7 | 13.5 | 10.9 | 17.0 | 13.4 | 17.5 | 16.0 | 15.5 | 13.3 | 10.6 | 9.7 |
| 25 | 9.5 | 9.8 | 12.5 | 10.9 | 16.5 | 13.2 | 15.5 | 15.0 | 15.3 | 13.4 | 10.5 | 9.7 |
| 26 | 9.5 | 9.9 | 12.0 | 10,8 | 16.5 | 13.2 | 14.0 | 14.0 | 15.1 | 13.2 | 10.5 | 9.6 |
| 27 | 9.5 | 15.1 | 12.0 | 10.8 | 16.0 | 13.0 | 13.8 | 12.5 | 15.0 | 17.2 | 10.5 | 10.0 |
| 28 | 9.5 | 16.1 | 12.0 | 10.8 | 15.5 | 12.8 | 12.8 | 12.0 | 15.0 | 17.2 | 10.5 | 10.2 |
| 29 | 9.7 | ....... | 12.0 | 10.8 | 24.0 | 11.6 | 13.5 | 11.5 | 14.8 | 15.0 | 10.5 | 10.6 |
| 30 | 9.7 | ....... | 12.1 | 10.8 | 20.0 | 11.0 | 17.5 | 11.2 | 14.6 | 14.0 | 11.0 | 10.6 |
| 31 | 9.8 | ....... | 12.5 | ....... | 19.0 | ....... | ....... | 11.0 | ....... | 13.5 | ....... | 10.5 |

NOTE.—River frozen over February 4-11, inclusive.

## CANADIAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Canadian River rises in the mountains of Colfax County, N. Mex., flows southward across Mora and San Miguel counties, then turns to the east and flows across northern Texas, Oklahoma, and Indian Territory, uniting with Arkansas River about 80 miles above Fort Smith, Ark.

The drainage area is wooded in the upper portion and in Indian Territory, but consists of dry plains in Texas and Oklahoma. There are few tributaries, Ute Creek and Mora and Sapello rivers in New Mexico being the principal ones. The run-off is very uncertain, varying from extreme floods to practically nothing in a dry season.

### CANADIAN RIVER AT CALVIN, IND. T.

This station was established in 1904 by the United States Weather Bureau. It is located at the railroad bridge about one-fourth mile west of Calvin, Ind. T.

The channel is straight for 2,000 feet above and below the station. The current is swift, and is oblique to the bridge at times. Neither bank will overflow beyond the limits of the bridge and trestle approach. The bed of the stream is composed of clean sand, and is shifting. There is but one channel, divided by the piers of the bridge and somewhat obstructed by old piles and drift caught on them.

Discharge measurements are made from the upstream side of the three-span bridge to which the gage is attached. The bridge has a total length of 835 feet, with a trestle approach of 30 feet at the left bank. The initial point for soundings is the face of the right abutment, upstream side.

A standard chain gage is fastened to the upstream side of the bridge near the middle of the stream; length of the chain, 28.00 feet. During 1905 the gage was read once each day by the United States Weather Bureau observer. Bench marks were established as follows: (1) A United States Geological Survey standard bench-mark post, marked "715," about 100 yards west of the Calvin depot; elevation, 28.72 feet. (2) On the right abutment, upstream side; elevation, 20.42 feet. (3) On the upstream end of the crossbeam, 353 feet from the initial point; elevation, 26.32 feet.

*Discharge measurements of Canadian River at Calvin, Ind. T., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 28 | J. M. Giles | 622 | 1,578 | 5.38 | 4.37 | 8,496 |
| July 28 | do | 622 | 1,533 | 5.81 | 4.32 | 8,916 |
| July 29 | do | 496 | 1,590 | 4.44 | 4.15 | 7,054 |
| July 29 | do | 479 | 1,518 | 4.26 | 4.05 | 6,466 |
| September 24 | E. R. Kerby | 155 | 272 | 1.98 | 2.40 | 539 |
| September 27 | J. M. Giles | 114 | 168 | 1.48 | 2.22 | 248 |
| September 27 | do | 114 | 160 | 1.46 | 2.21 | 233 |
| October 10 | E. R. Kerby | 60 | 50 | 1.82 | 2.00 | 91 |
| November 16 | do | | 1,163 | 3.94 | 3.70 | 4,589 |
| November 18 | do | | 869 | 2.90 | 3.20 | 2,520 |
| December 12 | do | | 203 | 2.39 | 2.70 | 486 |

*Daily gage height, in feet, of Canadian River at Calvin, Ind. T., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.4 | 0.1 | 2.1 | 1.5 | 4.1 | 6.0 | 2.4 | 5.2 | 2.1 | 2.1 | 1.9 | 4.7 |
| 2 | .3 | ....... | 1.8 | 1.7 | 3.8 | 4.8 | 3.1 | 2.9 | 2.0 | 4.4 | 1.9 | 3.8 |
| 3 | .3 | ....... | 1.5 | 3.2 | 3.3 | 4.1 | 3.1 | 2.8 | 2.2 | 2.9 | 1.9 | 3.3 |
| 4 | .3 | ....... | 1.2 | 2.7 | 3.8 | 3.7 | 3.2 | 2.7 | 2.0 | 2.7 | 2.2 | 3.1 |
| 5 | .2 | ....... | 1.1 | 2.3 | 4.0 | 3.4 | 3.1 | 2.4 | 2.2 | 2.3 | 2.6 | 3.0 |
| 6 | .2 | ....... | 1.5 | 2.0 | 4.1 | 3.2 | 3.1 | 2.6 | 2.0 | 2.2 | 2.2 | 2.8 |
| 7 | .2 | ....... | 2.0 | 4.0 | 3.9 | 3.0 | 3.0 | 2.9 | 1.9 | 2.1 | 2.1 | 2.4 |
| 8 | .2 | ....... | 1.9 | 3.8 | 3.7 | 2.8 | 2.8 | 4.0 | 2.2 | 2.0 | 2.3 | 2.2 |
| 9 | .2 | ....... | 2.2 | 3.4 | 3.5 | 2.8 | 2.7 | 3.7 | 2.7 | 2.0 | 2.6 | 2.0 |
| 10 | .6 | ....... | 1.8 | 3.0 | 3.2 | 3.7 | 3.6 | 3.4 | 4.2 | 2.0 | 2.3 | 2.6 |
| 11 | .8 | ....... | 1.2 | 3.0 | 3.2 | 3.2 | 3.2 | 3.1 | 4.0 | 2.0 | 2.6 | 2.6 |
| 12 | 1.0 | ....... | 1.7 | 2.6 | 3.4 | 3.8 | 3.0 | 3.0 | 4.7 | 1.9 | 2.5 | 2.6 |
| 13 | ....... | ....... | 1.6 | 2.5 | 4.6 | 3.4 | 3.0 | 2.9 | 4.6 | 1.9 | 2.4 | 2.8 |
| 14 | ....... | ....... | 1.7 | 2.8 | 4.5 | 2.9 | 3.0 | 3.1 | 4.3 | 2.0 | 2.3 | 3.0 |
| 15 | ....... | ....... | 2.1 | 2.5 | 3.7 | 2.4 | 3.4 | 3.6 | 3.7 | 1.8 | 4.4 | 2.5 |
| 16 | ....... | ....... | 2.0 | 2.5 | 3.7 | 2.7 | 3.2 | 4.2 | 3.6 | 1.9 | 3.9 | 2.5 |
| 17 | ....... | ....... | 1.8 | 2.6 | 3.4 | 2.3 | 3.6 | 5.2 | 2.9 | 2.2 | 3.8 | 2.6 |
| 18 | .6 | ....... | 2.4 | 2.4 | 3.1 | 2.6 | 3.6 | 4.0 | 2.8 | 2.3 | 3.2 | 2.7 |
| 19 | .5 | ....... | 2.2 | 3.0 | 3.0 | 2.5 | 3.6 | 3.6 | 2.8 | 2.2 | 3.0 | 2.6 |
| 20 | .5 | ....... | 2.5 | 3.0 | 7.0 | 2.8 | 4.1 | 3.8 | 2.5 | 2.0 | 3.0 | 3.8 |
| 21 | .5 | ....... | 2.8 | 2.9 | 6.0 | 2.9 | 3.4 | 3.1 | 2.5 | 2.0 | 2.9 | 3.6 |
| 22 | .5 | 1.1 | 2.3 | 2.9 | 6.5 | 2.6 | 3.1 | 3.0 | 2.4 | 2.0 | 2.8 | 3.4 |
| 23 | .3 | 1.9 | 2.1 | 2.8 | 5.7 | 2.2 | 3.2 | 2.8 | 2.4 | 1.9 | 2.8 | 3.3 |
| 24 | .2 | 2.8 | 1.9 | 2.7 | 4.1 | 2.6 | 3.1 | 2.5 | 2.4 | 2.0 | 3.1 | 3.2 |
| 25 | ....... | 2.2 | 1.8 | 2.8 | 3.8 | 2.2 | 3.0 | 2.4 | 2.3 | 2.0 | 2.5 | 3.0 |
| 26 | ....... | 3.5 | 1.7 | 3.5 | 4.8 | 2.5 | 3.4 | 2.3 | 2.2 | 2.0 | 2.5 | 3.0 |
| 27 | ....... | 2.7 | 1.7 | 2.8 | 14.8 | 2.2 | 2.8 | 2.3 | 2.2 | 1.9 | 2.5 | 2.9 |
| 28 | .1 | 2.5 | 2.0 | 6.5 | 8.4 | 2.1 | 2.7 | 2.2 | 2.1 | 1.9 | 3.0 | 3.0 |
| 29 | .2 | ....... | 2.0 | 5.4 | 10.0 | 2.8 | 4.2 | 2.2 | 2.2 | 1.9 | 5.4 | 3.0 |
| 30 | .1 | ....... | 2.0 | 5.0 | 8.0 | 2.4 | 3.8 | 2.2 | 2.1 | 1.9 | 4.9 | 2.9 |
| 31 | .1 | ....... | 1.6 | ....... | 7.2 | ....... | 3.7 | 2.1 | ....... | 1.9 | ....... | 3.0 |

**NOTE.—River frozen January 13-17, 25-27, and February 2-21.**

*Station rating table for Canadian River at Calvin, Ind. T., from July 1 to November 30, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 10 | 2.80 | 1,310 | 3.80 | 4,870 | 4.80 | 12,160 |
| 1.90 | 40 | 2.90 | 1,570 | 3.90 | 5,440 | 4.90 | 13,000 |
| 2.00 | 90 | 3.00 | 1,840 | 4.00 | 6,060 | 5.00 | 13,850 |
| 2.10 | 160 | 3.10 | 2,120 | 4.10 | 6,720 | 5.10 | 14,700 |
| 2.20 | 260 | 3.20 | 2,420 | 4.20 | 7,420 | 5.20 | 15,600 |
| 2.30 | 380 | 3.30 | 2,740 | 4.30 | 8,150 | 5.30 | 16,500 |
| 2.40 | 520 | 3.40 | 3,080 | 4.40 | 8,910 | 5.40 | 17,400 |
| 2.50 | 680 | 3.50 | 3,460 | 4.50 | 9,700 | | |
| 2.60 | 860 | 3.60 | 3,880 | 4.60 | 10,510 | | |
| 2.70 | 1,070 | 3.70 | 4,350 | 4.70 | 11,330 | | |

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 2 feet and 4.5 feet. Owing to the shifting character of the stream the table should not be applied prior to July 1, as there were no measurements before that date. The only measurement in December indicates a decided change in conditions For that reason no estimate is made.

*Estimated monthly discharge of Canadian River at Calvin, Ind. T., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| July | 7,420 | 520 | 2,742 | 168,600 |
| August | 15,600 | 160 | 3,017 | 185,500 |
| September | 11,330 | 40 | 2,087 | 124,200 |
| October | 8,910 | 10 | 476 | 29,270 |
| November | 17,400 | 40 | 2,500 | 148,800 |
| The period | | | | 656,400 |

## CANADIAN RIVER NEAR LOGAN, N. MEX.

This station was established June 29, 1904, by W. G. Russell. It is located at the bridge of the Chicago, Rock Island and Pacific Railroad, 1 mile west of the depot at Logan, N. Mex- The station was discontinued February 26, 1905, though discharge measurements were made afterward.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pages 160–162.

*Discharge measurements of Canadian River near Logan, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Second-feet.* |
| October 10 | Earl Patterson | 30 | 22 | 0.61 | 14 |
| November 20 | do | 43 | 43 | 1.70 | 73 |

*Daily gage height, in feet, of Canadian River near Logan, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Day. | Jan. | Feb. | Day. | Jan. | Feb. |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 2.1 | 12 | 2.0 | 2.0 | 23 | 2.0 | 2.6 |
| 2 | 2.0 | 2.1 | 13 | 2.0 | 2.0 | 24 | 2.0 | 2.6 |
| 3 | 2.0 | 2.1 | 14 | 2.0 | 2.0 | 25 | 2.0 | 2.55 |
| 4 | 2.0 | 2.1 | 15 | 2.0 | 2.0 | 26 | 2.0 | 2.4 |
| 5 | 2.0 | 2.2 | 16 | 2.0 | 2.0 | 27 | 2.0 | |
| 6 | 2.0 | 2.2 | 17 | 2.9 | 2.1 | 28 | 2.0 | |
| 7 | 2.0 | 2.2 | 18 | 2.9 | 2.1 | 29 | 2.2 | |
| 8 | 2.1 | 2.1 | 19 | 2.9 | 2.2 | 30 | 2.2 | |
| 9 | 2.1 | 2.1 | 20 | 2.9 | 2.85 | 31 | 2.2 | |
| 10 | 2.1 | 2.1 | 21 | 2.9 | 3.25 | | | |
| 11 | 2.1 | 2.0 | 22 | 2.9 | 2.65 | | | |

## MORA RIVER AT LA CUEVA, N. MEX.

This station was established August 25, 1903, by M. C. Hinderlider. It is located at the wagon bridge at the village of La Cueva, N. Mex. La Cueva is situated in the Mora land grant, 26 miles directly north of Las Vegas. During the flood of September 29, 1904, the bridge to which the gage was attached was carried away and as a result records were discontinued for the remainder of the year. The station was reestablished April 29, 1905, at the old section, the bridge having been replaced.

This station is one-fourth mile below the dam site of the La Cueva reservoir, and was established to determine the amount of water available for storage in the reservoir for use on valley lands below. The Mora canal diverts water from Mora River a short distance above this gaging station. At low water practically the entire flow of the river is diverted by this canal, part of it being at times used for power for a gristmill and returned to the river above the station. At other times the entire volume in the canal is carried through to a system of storage reservoirs, below which the water is used for irrigation. No data of value concerning the canal have been secured during 1905.

The channel is straight for 50 feet above and 120 feet below the station. The bed of the stream is composed of solid rock which is partly covered with a loose deposit of shifting sand and gravel. The left bank consists of sand and gravel, is low, and overflows at high water. The right bank is a series of sandstone ledges. There is but one channel at all stages.

The bridge from which discharge measurements are made is not quite at a right angle to the stream flow.

The original gage was a vertical rod fastened to the west end of the north abutment of the bridge. April 29, 1905, a staff gage was fastened vertically to the west side of the south abutment of the bridge, the datum being 1.32 feet above that of the original gage. During 1905 the gage was read twice each day by Hugh Loudon, secretary of the La Cueva Land and Cattle Company. The bench mark is a cross cut in the vertical face of the limestone ledge just above the south end of the bridge, marked "U. S. G. S., B. M.;" elevation, 4.51 feet above the datum of the new gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 99, p 249; 131, pp 162-163.
Gage heights: 99, p 249; 131, p 163.

*Discharge measurements of Mora River at La Cueva, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 29 | R. I. Meeker | 24 | 69 | 4.50 | 3.40 | 310 |
| July 2 | do | 18 | 15 | 1.60 | .85 | 24 |
| August 1 | do | 22 | 20 | 1.70 | 1.10 | 34 |

*Daily gage height, in feet, of Mora River at La Cueva, N. Mex., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 0.55 | 1.0 | 3.2 | 2.2 | 0.85 | 1.1 | [a]0.8 | 0.8 | 0.9 | 0.9 |
| 2 | ....... | [a].7 | .75 | 3.4 | 2.2 | .8 | 1.55 | .85 | .9 | .9 | .9 |
| 3 | ....... | .85 | .75 | 3.4 | 2.2 | .8 | 1.4 | .85 | .9 | .9 | .9 |
| 4 | ....... | .85 | .7 | 3.0 | 2.7 | .8 | 1.5 | .9 | .9 | .9 | .9 |
| 5 | ....... | .85 | .7 | 2.8 | ....... | .8 | 1.4 | 1.0 | .9 | .9 | .9 |
| 6 | ....... | 1.5 | .85 | 2.5 | ....... | .8 | 1.7 | .9 | .9 | .9 | .9 |
| 7 | ....... | 1.3 | 1.15 | 2.5 | ....... | .75 | 1.4 | .85 | .8 | .9 | .85 |
| 8 | ....... | 1.1 | 1.4 | 2.55 | ....... | .75 | 1.4 | .9 | .8 | .9 | 1.0 |
| 9 | ....... | 1.1 | 1.6 | 2.9 | ....... | .8 | 1.3 | .95 | .8 | .95 | .9 |
| 10 | ....... | 1.1 | 1.7 | 2.6 | 2.1 | .75 | 1.2 | .95 | .8 | .9 | .95 |
| 11 | ....... | 1.05 | 1.7 | 2.4 | 2.0 | .75 | 1.2 | .9 | .7 | .9 | .85 |
| 12 | ....... | [a]1.05 | 1.55 | 2.4 | 2.0 | .75 | 1.1 | .9 | .8 | .9 | .9 |
| 13 | ....... | 1.05 | 1.5 | 2.4 | 1.9 | .7 | 1.1 | .85 | .8 | .9 | .9 |
| 14 | ....... | 1.05 | 1.45 | 2.3 | 1.8 | .7 | 1.1 | .85 | .8 | .9 | .9 |
| 15 | ....... | 1.05 | 1.4 | 2.2 | 1.7 | .7 | 1.0 | .8 | .8 | .9 | .9 |
| 16 | ....... | [a]1.0 | 1.45 | 2.4 | 1.65 | .7 | 1.0 | .75 | .6 | .9 | .9 |
| 17 | ....... | 1.0 | 1.4 | 2.5 | 1.6 | .7 | .95 | .8 | .8 | .9 | .9 |
| 18 | ....... | .8 | 1.45 | 2.5 | [a]1.5 | .7 | .9 | .8 | .8 | .9 | .9 |
| 19 | ....... | .85 | 1.5 | 2.6 | 1.4 | .7 | .85 | .8 | .8 | .9 | 1.0 |
| 20 | ....... | .9 | [a]1.5 | 2.7 | 1.4 | .7 | .85 | .6 | .75 | .9 | 1.05 |
| 21 | ....... | .85 | 1.5 | 2.5 | 1.3 | .7 | .75 | .55 | .95 | .9 | .9 |
| 22 | 0.4 | .8 | 1.55 | 2.4 | 1.3 | .9 | .7 | .55 | .9 | 1.05 | .9 |
| 23 | .45 | .8 | 2.1 | 2.5 | 1.2 | .9 | .8 | .6 | .9 | 1.0 | ...... |
| 24 | .45 | .75 | 2.0 | 2.5 | 1.2 | .8 | .8 | .6 | 1.0 | .9 | ...... |
| 25 | .45 | .8 | 2.1 | 2.3 | 1.2 | .75 | .8 | .6 | .95 | .9 | ...... |
| 26 | .5 | .85 | 2.3 | 2.5 | 1.1 | .7 | .8 | .65 | .95 | .9 | ...... |
| 27 | .6 | [a].8 | 2.9 | 2.3 | 1.05 | [a].7 | .8 | .7 | .9 | 1.1 | ...... |
| 28 | .55 | .75 | 3.0 | 2.4 | 1.0 | .75 | .8 | .6 | .95 | 1.0 | ...... |
| 29 | ....... | .65 | 3.3 | 2.2 | .9 | .75 | .7 | .7 | .9 | 1.0 | ...... |
| 30 | ....... | .75 | 3.3 | 2.1 | .9 | .8 | .7 | .6 | .9 | 1.0 | ...... |
| 31 | ....... | .7 | ....... | 2.2 | ....... | .9 | [a].75 | ....... | .9 | ....... | ...... |

[a] Interpolated.

NOTE.—River frozen December 23-31.

*Station rating table for Mora River at La Cueva, N. Mex., from February 22 to December 22, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet* | *Feet.* | *Second-feet* | *Feet* | *Second-feet* |
| 0.20 | 12 | 1.10 | 34 | 2.00 | 105 | 2.90 | 224 |
| 0.30 | 13 | 1.20 | 39 | 2.10 | 115 | 3.00 | 240 |
| 0.40 | 14 | 1.30 | 45 | 2.20 | 126 | 3.10 | 257 |
| 0.50 | 16 | 1.40 | 52 | 2.30 | 138 | 3.20 | 274 |
| 0.60 | 18 | 1.50 | 60 | 2.40 | 151 | 3.30 | 292 |
| 0.70 | 21 | 1.60 | 68 | 2.50 | 164 | 3.40 | 310 |
| 0.80 | 24 | 1.70 | 77 | 2.60 | 178 | | |
| 0.90 | 27 | 1.80 | 86 | 2.70 | 193 | | |
| 1.00 | 30 | 1.90 | 95 | 2.80 | 208 | | |

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. On account of the small number of measurements, it should be considered as only approximate.

*Estimated monthly discharge of Mora River at La Cueva, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February 22-28 | 18 | 14 | 15.7 | 218 |
| March | 60 | 17 | 28.2 | 1,734 |
| April | 202 | 21 | 87.1 | 5,183 |
| May | 310 | 115 | 175. | 10,760 |
| June (25 days) | 193 | 27 | 72.6 | 3,600 |
| July | 27 | 21 | 22.8 | 1,402 |
| August | 77 | 21 | 35.0 | 2,152 |
| September | 30 | 17 | 23.2 | 1,380 |
| October | 30 | 18 | 25.4 | 1,562 |
| November | 34 | 27 | 27.8 | 1,654 |
| December 1-22 | 32 | 26 | 27.5 | 1,200 |
| The period | | | | 30,840 |

## SAPELLO RIVER AT LOS ALAMOS, N. MEX.

This station was established August 22, 1903, by M. C. Hinderlider. It is located at a ford crossing Sapello River at a point about one-fourth mile due north from Los Alamos, N. Mex. Los Alamos is about 13 miles north of Las Vegas. The establishment of this station was for the purpose of determining the available amount of water for prospective diversion into the San Guijuela reservoir for the Las Vegas project. This basin lies about 6 miles northwest of Las Vegas.

The channel at the cable is about 125 feet wide and is straight above and below for 200 feet each way. The bed is composed of bowlders, cobblestones, sand, and gravel. The banks are of alluvial material, which erodes easily, and are about 10 feet high. There is but one channel at all stages. Gage heights range from 0 to 5 feet. The current is strong at all stages.

Discharge measurements were originally made by wading. In March, 1904, a cable, car, and tagged wire were installed for use during high water.

The original gage was an inclined staff 500 feet below the cable. September 29, 1904, the gage was destroyed by a disastrous flood which swept down this valley. Records were discontinued until April, 1905, when a standard chain gage was installed near the cable, about 400 feet above the location of the original gage. This gage is fastened to a cantilever arm on the right bank. The length of the chain is 15.44 feet. During 1905 the gage was read by W. N. Frank, jr. The bench mark is a nail driven into the post supporting the cable at the right bank; elevation, 11.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 249-250; 131, pp 166-167.
Discharge: 99, p 250; 131, p 167.
Gage heights: 99, p 250; 131, p 168.

*Discharge measurements of Sapello River at Los Alamos, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 3 | R. I. Meeker | 12 | 13 | 2.23 | 0.90 | 29 |
| April 28 | do | 73 | 91 | 5.25 | 2.60 | 478 |
| July 1 | do | 12 | 7.5 | 1.68 | .40 | 13 |
| August 2 | do | 12 | 11 | 1.73 | .65 | 19 |

**NOTE.—Measurements made at different sections.**

*Daily gage height, in feet, of Sapello River at Los Alamos, N. Mex., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.5 | 1.5 | 2.25 | 1.4 | 0.4 | 0.7 | 0.1 | 0.1 | 0.1 | 0.8 |
| 2 | ...... | 2.0 | 1.6 | 2.55 | 1.4 | .4 | .7 | .15 | .1 | .1 | .8 |
| 3 | 0.9 | 1.75 | 1.55 | 2.45 | 1.4 | .3 | .65 | .4 | .1 | .1 | .8 |
| 4 | .9 | 1.7 | 1.65 | 2.0 | 1.35 | .3 | .65 | .4 | .1 | .15 | .6 |
| 5 | .95 | 1.7 | 1.85 | 2.0 | 1.2 | .25 | 1.15 | .3 | .1 | .1 | .6 |
| 6 | 1.0 | 2.75 | 1.9 | 1.85 | 1.15 | .2 | .8 | .1 | .1 | .1 | .6 |
| 7 | .95 | 2.15 | 1.95 | 1.85 | 1.1 | .0 | .7 | .15 | .1 | .1 | .6 |
| 8 | .9 | 1.75 | 1.85 | 1.85 | 1.45 | .0 | .7 | .35 | .1 | .15 | .5 |
| 9 | 1.7 | 1.65 | 1.85 | 1.9 | 1.35 | .0 | .6 | .85 | .1 | .1 | .5 |
| 10 | 1.05 | 1.6 | 1.85 | 1.75 | 1.25 | .0 | .5 | .1 | .1 | .1 | .5 |
| 11 | .95 | 1.55 | 1.8 | 1.75 | 1.25 | .0 | 1.3 | .1 | .1 | .1 | .5 |
| 12 | .95 | 1.5 | 1.8 | 1.7 | 1.2 | .0 | 1.2 | .1 | .1 | .1 | .5 |
| 13 | .95 | 1.5 | 1.75 | 1.7 | 1.2 | .0 | .6 | .2 | .1 | .1 | .5 |
| 14 | .95 | 1.4 | 1.6 | 1.65 | .95 | .1 | .5 | .1 | .1 | .1 | .5 |
| 15 | 1.15 | 1.4 | 1.6 | 1.6 | .9 | .1 | .45 | .1 | .1 | .1 | .5 |
| 16 | 1.25 | 1.4 | 1.6 | 1.55 | .9 | .1 | .35 | .1 | .1 | .1 | .5 |
| 17 | 1.25 | 1.3 | 1.55 | 1.6 | .75 | .1 | .35 | .1 | .1 | .1 | .5 |
| 18 | 1.15 | 1.25 | 1.55 | 1.7 | .7 | .15 | .3 | .1 | .1 | .1 | .5 |
| 19 | 1.15 | 1.15 | 1.55 | 1.8 | .65 | .1 | .2 | .1 | .1 | .1 | .5 |
| 20 | 1.1 | 1.15 | 1.5 | 1.8 | .6 | .1 | .25 | .2 | .1 | .1 | .5 |
| 21 | 1.35 | 1.15 | 1.5 | 1.85 | .5 | .1 | .2 | .1 | .1 | .1 | .5 |
| 22 | 1.25 | 1.2 | 1.6 | 1.75 | .65 | .1 | .2 | .1 | .1 | .9 | .5 |
| 23 | 1.35 | 1.25 | 2.45 | 1.75 | .45 | .35 | .2 | .1 | .1 | .6 | .5 |
| 24 | 1.35 | 1.25 | 3.45 | 1.7 | .55 | .45 | .2 | .1 | .1 | .6 | .5 |
| 25 | 1.35 | 1.25 | 3.8 | 1.6 | .55 | .4 | .2 | .1 | .1 | .6 | .5 |
| 26 | 1.4 | 1.25 | 3.35 | 1.6 | .55 | .25 | .2 | .15 | .1 | .6 | .5 |
| 27 | 1.4 | 1.25 | 3.05 | 1.55 | .45 | .15 | .1 | .2 | .1 | 1.9 | .5 |
| 28 | 1.5 | 1.25 | 2.5 | 1.5 | .35 | .1 | .15 | .2 | .1 | .9 | .5 |
| 29 | ...... | 1.15 | 2.45 | 1.45 | .35 | .15 | .15 | .2 | .1 | .9 | .5 |
| 30 | ...... | 1.15 | 2.4 | 1.45 | .4 | .2 | .2 | .1 | .1 | .9 | .5 |
| 31 | ...... | 1.25 | ...... | 1.4 | ...... | 1.35 | .15 | ...... | .1 | ...... | .5 |

## UTE CREEK NEAR LOGAN, N. MEX.

This station was established August 12, 1904, by W. G. Russell. It is located about 7 miles northwest of Logan, N. Mex., and about 4 miles above the mouth of Ute Creek, near the old Martinez house.

The channel is straight for about 300 feet above the station. The current is sluggish at low and swift at high stages. The right bank is low, clean, and subject to overflow. The left bank is high, rocky, and wooded, and does not overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages.

Discharge measurements are made at low water by wading near the gage. Discharges for high stages must be computed from the slope and cross section. The initial point for soundings is at the gage on the left bank of the stream.

The original gage was washed out May 23, 1905. A new gage was established at the same datum June 30, 1905, the record being kept in the meantime by measuring down from a bench mark. The new gage is an inclined staff fastened to the rock on the left bank of the creek, about 100 feet above the site of the old gage. During 1905 the gage was read once each day by Manuel Martinez. Bench marks were established as follows: (1) A cross painted on the top of a rock on the left bank 200 feet below the gage; elevation, 5.51 feet. (2) The head of a bolt set in a rock 14 feet west of the gage; elevation, 3.46 feet. (3) A cross cut in a sandstone ledge directly over the gage; elevation, 11.89 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 170–171.

*Discharge measurements of Ute Creek near Logan, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 3 | J. M. Giles | 6 | 4.3 | 0.90 | 0.50 | 3.9 |
| June 6 | Earl Patterson | 36 | 13.1 | 1.35 | .80 | 17.7 |
| June 30 | do | 10 | 1.71 | .73 | .65 | 1.3 |
| July 1 | do | 68 | 58 | 3.31 | 1.50 | 194 |
| July 1 | do | 68 | 46 | 3.13 | 1.30 | 145 |
| July 1 | do | 70 | 67 | 3.98 | 1.60 | 266 |
| July 1 | do | 70 | 74 | 4.22 | 1.70 | 311 |
| July 2 | do | 54 | 32 | 2.50 | 1.15 | 80 |
| July 2 | do | 84 | 25 | 2.42 | 1.05 | 60 |
| August 20 | do | 7 | 2 | .63 | .75 | 1.4 |
| October 10 | do | 1 | .13 | .14 | .70 | .02 |
| November 20 | do | | 4.9 | 1.04 | .90 | 5.1 |
| December 15 | do | 44 | 17 | 1.13 | 1.10 | 19 |

*Daily gage height, in feet, of Ute Creek near Logan, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.3 | 0.3 | 0.8 | 0.6 | 0.8 | 1.2 | 1.8 | 4.9 | 0.8 | 0.8 | | 1.2 |
| 2 | .3 | .3 | .8 | 3.8 | .6 | .9 | 1.1 | 4.8 | .8 | .8 | | 1.1 |
| 3 | .2 | .3 | .8 | 2.9 | .5 | .6 | 1.1 | 4.5 | .8 | .8 | | 1.1 |
| 4 | .2 | .3 | .8 | 2.2 | .4 | .6 | .9 | 2.9 | .8 | .8 | | 1.0 |
| 5 | .2 | .3 | .6 | 1.8 | .3 | .6 | .8 | 1.1 | 2.5 | .7 | | .9 |
| 6 | .2 | .3 | .8 | 1.6 | .3 | .8 | .7 | 1.3 | 1.9 | .7 | | .9 |
| 7 | .2 | .3 | .8 | 1.4 | .3 | .8 | .6 | 1.9 | 2.9 | | | .8 |
| 8 | .2 | .3 | .6 | 1.2 | .3 | .8 | .6 | 3.3 | 2.4 | | 1.2 | .7 |
| 9 | .2 | .3 | .6 | 1.1 | .3 | .8 | .6 | 2.5 | 1.5 | | 2.1 | .6 |
| 10 | .2 | .3 | .6 | .9 | .3 | .9 | .6 | 1.9 | 1.8 | | 1.9 | .6 |
| 11 | .3 | .3 | .4 | .9 | .3 | .9 | .5 | 1.4 | 1.8 | | 1.5 | .6 |
| 12 | .3 | .3 | .9 | .9 | .2 | .8 | .5 | 1.0 | 1.6 | | 1.8 | .6 |
| 13 | .4 | .3 | .9 | .9 | .2 | .6 | .5 | 1.0 | 1.1 | | 1.8 | 1.4 |
| 14 | .4 | .3 | .9 | .8 | .2 | .5 | .4 | .9 | .9 | | 1.9 | 1.2 |
| 15 | .4 | .4 | .9 | .8 | .2 | .3 | .4 | 1.1 | .8 | | 1.9 | 1.2 |
| 16 | .4 | .4 | .8 | .4 | .2 | .2 | .4 | .9 | 1.3 | | 1.6 | 1.2 |
| 17 | .4 | .4 | .8 | .4 | .2 | .2 | .4 | .8 | 1.1 | | 1.1 | 1.2 |
| 18 | .4 | .3 | .8 | .4 | .2 | .2 | .4 | .6 | 1.1 | | .9 | 1.2 |
| 19 | .5 | .3 | .4 | .4 | .2 | .2 | .4 | .6 | .9 | | .9 | 1.2 |
| 20 | .5 | .8 | .4 | .3 | 1.6 | .2 | .4 | .6 | .7 | | .9 | 1.2 |
| 21 | .5 | 1.1 | .5 | .4 | .9 | .4 | .9 | .5 | .7 | | .9 | 1.2 |
| 22 | .5 | .9 | .5 | .4 | .8 | .3 | 1.5 | .5 | .7 | | 1.0 | 1.1 |
| 23 | .5 | .9 | .6 | 3.5 | 8.8 | .2 | 1.1 | .5 | .7 | | 2.8 | 1.0 |
| 24 | .5 | 1.6 | .6 | 3.8 | 5.3 | .2 | .9 | .5 | .7 | | 1.6 | 1.0 |
| 25 | .5 | 1.4 | .6 | 3.3 | 3.9 | .2 | .9 | .5 | .7 | | 1.3 | 1.0 |
| 26 | .4 | 1.1 | .6 | 2.5 | 8.8 | .2 | .8 | .5 | .9 | | 1.3 | 1.0 |
| 27 | .4 | .9 | .5 | 2.1 | 3.9 | .2 | .8 | .5 | .9 | | 1.3 | 1.0 |
| 28 | .4 | .9 | .4 | 1.5 | 2.2 | .2 | .6 | .8 | .8 | | 1.3 | 1.0 |
| 29 | .4 | | .3 | 1.0 | 1.9 | .5 | .5 | .9 | .8 | | 1.3 | .9 |
| 30 | .3 | | .3 | .9 | 1.7 | 1.8 | 5.2 | .9 | .8 | | 1.2 | .9 |
| 31 | .3 | | .3 | | 1.5 | | 5.1 | .8 | | | | .9 |

**Note.**—Creek dry October 7 to November 7, inclusive.

## BEAVER CREEK AT BEAVER, OKLA.

This station was established March 29, 1904, by W. G. Russell, and was discontinued December 31, 1905. It is located just below the ford about one-fourth mile north of Beaver, Okla.

The channel is straight for about 300 feet above and below the station and about 95 feet wide at ordinary stages. During the flood of July, 1904, the river was 2,547 feet wide along the highway and across the ford, and the stream bed was eroded. The current is sluggish at low water, but has a good current at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of clean sand and is shifting. There is but one channel at all stages.

Discharge measurements are made at low water by wading. It is not possible to make high-water measurements in this vicinity, and the discharge during floods must be computed from the slope and cross section. The initial point for soundings is at the gage.

The original gage was destroyed July 9, 1904. A new inclined gage at the same datum was fastened to posts driven into the bank of the river. June 18, 1905, a similar gage was erected 440 feet downstream and was set to give the same reading at gage height 0.80 foot, the datum being 0.44 foot lower than that of the upper gage. By reading both gages at flood stage the surface slope may be obtained. During 1905 the gage was read once each day by Logan Rock. The bench mark is the top of a pine stake about 0.5 foot above the surface of the ground, 15 feet south of the gage; elevation, 5.00 feet above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 131, United States Geological Survey, pp. 171-172.

*Discharge measurements of Beaver Creek at Beaver, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 17 | J. M. Giles | 36 | 38 | 1.11 | 0.87 | 42 |
| June 18 | do | 48 | 32 | 1.26 | .82 | 40 |
| June 19 | do | 48 | 26 | 1.24 | .79 | 33 |
| August 25 | do | 40 | 32 | 1.33 | .95 | 42 |
| November 23 | E. Patterson | | 56 | 1.42 | 1.15 | 79 |
| November 23 | do | | 61 | 1.55 | 1.20 | 95 |
| (a) | J. M. Giles | | 200 | 1.94 | 2.00 | 388 |
| (a) | do | | 345 | 2.45 | 3.00 | 845 |
| (a) | do | | 525 | 2.84 | 4.00 | 1,491 |

(a) Computed from slope measurements, using Kutter's formula.

*Daily gage height, in feet, of Beaver Creek at Beaver, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 1.2 | 1.3 | 1.05 | 1.6 | 1.8 | 0.7 | 0.4 | 0.45 | 0.3 | 0.8 | 1.25 |
| 2 | 1.05 | 1.25 | 1.25 | 1.25 | 1.5 | 1.8 | .65 | .45 | .45 | .3 | .8 | 1.25 |
| 3 | .9 | 1.25 | 1.25 | 1.2 | 1.4 | 1.7 | .65 | .35 | .5 | .25 | .8 | 1.2 |
| 4 | .9 | 1.3 | 1.2 | 1.5 | 1.3 | 1.7 | .6 | .3 | .4 | .6 | .8 | 1.15 |
| 5 | .9 | 1.3 | 1.15 | 1.4 | 1.2 | 1.65 | .6 | 1.1 | .45 | .6 | 1.2 | 1.15 |
| 6 | .85 | 1.3 | 1.1 | 1.3 | 1.2 | 1.4 | .65 | .9 | .9 | .55 | 1.1 | 1.15 |
| 7 | .85 | 1.35 | 1.05 | 1.2 | 1.1 | 1.2 | .7 | .85 | 1.0 | .45 | 1.0 | 1.1 |
| 8 | .85 | 1.35 | 1.05 | 1.2 | 1.1 | 1.15 | .75 | .75 | 1.05 | .55 | 1.0 | 1.1 |
| 9 | .8 | 1.45 | 1.0 | 1.15 | 1.2 | 1.1 | .65 | .75 | 1.1 | .55 | 1.2 | 1.1 |
| 10 | .8 | 1.45 | 1.05 | 1.15 | 1.3 | 1.1 | .65 | .6 | 1.2 | .45 | 1.15 | 1.0 |
| 11 | .8 | 1.45 | 1.05 | 1.15 | 1.1 | 1.4 | .65 | .5 | 1.2 | .55 | 1.1 | .9 |
| 12 | .85 | 1.5 | 1.05 | 1.1 | 1.05 | 1.4 | .6 | .5 | 1.25 | .6 | 1.1 | .9 |
| 13 | .9 | 1.5 | 1.05 | 1.1 | 1.05 | 1.3 | .55 | .8 | 1.3 | .6 | 1.1 | .9 |
| 14 | .9 | 1.5 | 1.05 | 1.05 | 1.0 | 1.2 | .5 | .75 | 1.4 | .65 | 1.05 | .95 |
| 15 | .9 | 1.5 | 1.05 | 1.2 | 1.0 | 1.1 | .5 | .75 | 1.3 | .65 | 1.05 | .95 |
| 16 | .9 | 1.6 | 1.0 | 1.1 | 1.0 | .8 | .75 | .6 | 1.25 | .65 | 1.05 | .95 |
| 17 | .9 | 1.4 | 1.0 | 1.05 | .95 | .9 | .4 | .5 | 1.1 | .7 | 1.05 | 1.0 |
| 18 | .9 | 1.4 | 1.05 | 1.05 | .95 | .85 | .4 | 1.2 | 1.0 | .7 | 1.0 | 1.0 |
| 19 | .9 | 1.4 | 1.05 | 1.1 | 1.0 | .85 | .35 | 1.0 | .9 | .7 | 1.0 | 1.0 |
| 20 | 1.1 | 1.35 | 1.05 | 1.1 | 1.0 | .8 | .45 | .5 | .8 | .75 | .95 | 1.05 |
| 21 | 1.1 | 1.35 | 1.05 | 1.0 | 1.05 | .8 | .4 | .5 | .75 | .75 | .9 | 1.05 |
| 22 | 1.5 | 1.35 | 1.05 | 1.0 | 1.1 | .8 | .4 | .45 | .6 | .8 | .9 | 1.1 |
| 23 | 1.5 | 1.3 | 1.0 | 1.05 | 1.1 | 1.15 | .35 | 1.05 | .55 | .8 | 1.5 | 1.1 |
| 24 | 1.4 | 1.2 | .95 | 2.0 | 1.8 | 1.0 | .85 | 1.0 | .5 | .8 | 1.5 | 1.1 |
| 25 | 1.2 | 1.15 | .9 | 2.1 | 1.6 | 1.0 | .75 | 1.0 | .45 | .85 | 1.4 | 1.15 |
| 26 | 1.3 | 1.15 | .9 | 2.0 | 3.0 | .85 | 1.6 | .85 | .45 | .85 | 1.35 | 1.2 |
| 27 | 1.25 | 1.15 | .85 | 3.0 | 2.6 | .85 | .85 | .8 | .4 | .85 | 1.35 | 1.25 |
| 28 | 1.25 | 1.15 | .85 | 2.7 | 2.7 | .8 | .85 | .75 | .35 | .8 | 1.35 | 1.3 |
| 29 | 1.2 | ....... | .8 | 2.1 | 3.1 | .75 | .8 | .7 | .3 | .8 | 1.3 | 1.4 |
| 30 | 1.25 | ....... | .8 | 1.7 | 2.6 | .7 | .75 | .7 | .3 | .8 | 1.3 | 1.4 |
| 31 | 1.2 | ....... | .85 | ....... | 2.5 | ....... | .4 | .6 | ....... | .85 | ....... | 1.45 |

## NORTH FORK OF CANADIAN RIVER NEAR WOODWARD, OKLA.

This station was established September 13, 1903, by W. G. Russell. It is located 7 miles east of Woodward, at the railroad bridge.

The channel is straight for 200 feet above and below the station. The right bank is high and not liable to overflow. The left bank is low and liable to overflow under the bridge; there are scattering trees along the bank. The bed of the stream is sandy and shifting. There is but one channel, broken by two piers at low water and five piers at high water.

Discharge measurements are made from the six-span railroad bridge, which has a total length between abutments of 360 feet. The initial point for soundings is at the west end of the bridge.

The original gage is painted on the west face of the second pier from the west end of the bridge. A standard chain gage is fastened to the downstream guard rail of the bridge; length of chain, 18.44 feet. During 1905 the gage was read by Adolph Mueller. The bench mark is the bottom of the coping stone of the pier at the top of the gage; elevation, 7.00 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 245; 131, pp 172-173.
Discharge: 131, p 173.
Gage heights: 99, p 246; 131, p 173.

*Discharge measurements of North Fork of Canadian River near Woodward, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 30 | W. W. Schlecht | 54 | 104 | 1.54 | 2.50 | 161 |
| April 2 | do | 172 | 148 | 1.21 | 2.65 | 179 |
| April 6 | do | 204 | 224 | 1.34 | 2.96 | 310 |
| April 15 | do | 185 | 130 | 1.46 | 2.76 | 191 |
| May 2 | W. G. Russell | 169 | 488 | 1.77 | 3.40 | 865 |
| May 3 | do | 157 | 351 | 2.16 | 3.20 | 759 |
| June 8 | J. M. Giles | 106 | 123 | 1.57 | 2.65 | 193 |
| June 8 | do | 142 | 173 | 1.18 | 2.65 | 205 |
| June 19 | Earl Patterson | 66 | 63 | 1.79 | 2.40 | 113 |
| June 22 | do | 162 | 196 | 1.76 | 2.90 | 346 |
| July 21 | do | 81 | 48 | 1.46 | 2.30 | 71 |
| August 17 | do | ....... | 282 | 1.77 | 3.50 | 500 |
| August 29 | do | 32 | 27 | 1.45 | 2.10 | 40 |
| September 19 | do | 40 | 37 | 1.40 | 2.30 | 52 |
| October 20 | J. M. Giles | 28 | 10 | .90 | 1.85 | 9 |
| October 28 | Earl Patterson | 35 | 25 | 1.26 | 2.20 | 31 |
| November 27 | do | ....... | 178 | 1.28 | 2.90 | 230 |
| December 17 | do | 161 | 101 | 1.31 | 2.80 | 133 |

*Daily gage height, in feet, of North Fork of Canadian River near Woodward, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.8 | 2.9 | 2.6 | 3.5 | 3.9 | 2.0 | 2.6 | 1.9 | 1.8 | 2.3 | 2.8 |
| 2 | 2.5 | 2.8 | 2.8 | 2.6 | 3.4 | 3.8 | 2.2 | 2.6 | 1.8 | 1.8 | 2.3 | 2.7 |
| 3 | 2.5 | 2.8 | 2.8 | 2.6 | 3.2 | 3.6 | 2.0 | 2.5 | 1.8 | 1.8 | 2.3 | 2.7 |
| 4 | 2.5 | 2.8 | 2.7 | 2.8 | 3.0 | 2.9 | 1.8 | 2.3 | 1.8 | 1.7 | 2.4 | 2.6 |
| 5 | 2.5 | 2.8 | 2.9 | 2.9 | 3.0 | 2.9 | 1.8 | 2.2 | 1.8 | 1.7 | 2.5 | 2.6 |
| 6 | 2.5 | 2.8 | 3.3 | 2.9 | 3.0 | 2.9 | 1.8 | 2.2 | 2.0 | 1.7 | 2.5 | 2.6 |
| 7 | 2.4 | 2.8 | 2.9 | 3.0 | 3.0 | 2.8 | 1.9 | 2.1 | 1.9 | 1.6 | 2.5 | 2.7 |
| 8 | 2.4 | 2.8 | 2.9 | 3.0 | 3.0 | 2.7 | 1.9 | 2.1 | 2.1 | 1.6 | 2.4 | 2.7 |
| 9 | 2.4 | 2.8 | 2.9 | 2.9 | 2.9 | 2.6 | 2.1 | 2.0 | 2.5 | 1.5 | 2.5 | 2.7 |
| 10 | 2.4 | 2.8 | 2.9 | 2.8 | 2.9 | 2.6 | 2.2 | 1.9 | 2.4 | 1.5 | 2.5 | 2.7 |
| 11 | 2.4 | 2.8 | 2.9 | 2.8 | 2.9 | 2.5 | 2.1 | 1.9 | 2.5 | 1.5 | 2.5 | 2.7 |
| 12 | 2.4 | 2.8 | 2.9 | 2.8 | 2.8 | 2.5 | 2.1 | 1.9 | 2.5 | 1.5 | 2.6 | 2.7 |
| 13 | 2.4 | 2.8 | 2.8 | 2.8 | 2.8 | 2.5 | 2.1 | 3.3 | 2.4 | 1.5 | 2.6 | 2.7 |
| 14 | 2.4 | 2.8 | 2.8 | 2.8 | 2.7 | 2.4 | 2.1 | 3.1 | 2.4 | 1.5 | 2.6 | 2.7 |
| 15 | 2.4 | 2.8 | 2.8 | 2.8 | 2.6 | 2.4 | 2.0 | 3.0 | 2.3 | 1.5 | 2.6 | 2.7 |
| 16 | 2.4 | 2.8 | 2.8 | 2.8 | 2.6 | 2.4 | 1.9 | 3.0 | 2.2 | 1.5 | 2.6 | 2.7 |
| 17 | 2.4 | 2.9 | 2.8 | 2.8 | 2.5 | 2.4 | 1.9 | 3.0 | 2.2 | 1.5 | 2.6 | 2.7 |
| 18 | 2.4 | 2.9 | 2.9 | 2.8 | 2.5 | 2.4 | 1.9 | 3.6 | 2.2 | 1.6 | 2.6 | 2.7 |
| 19 | 2.7 | 2.9 | 2.9 | 2.8 | 2.5 | 2.4 | 1.9 | 3.0 | 2.1 | 1.7 | 2.6 | 2.7 |
| 20 | 2.7 | 2.9 | 3.0 | 2.7 | 2.5 | 2.4 | 1.8 | 2.8 | 2.1 | 1.8 | 2.5 | 2.7 |
| 21 | 2.7 | 3.1 | 2.9 | 2.7 | 2.6 | 2.4 | 1.8 | 2.8 | 2.1 | 1.8 | 2.5 | 2.7 |
| 22 | 2.7 | 3.1 | 2.8 | 2.6 | 2.8 | 3.4 | 1.9 | 2.6 | 2.1 | 1.9 | 2.6 | 2.7 |
| 23 | 2.8 | 3.1 | 2.8 | 2.6 | 3.8 | 2.9 | 1.8 | 2.5 | 2.1 | 1.9 | 2.8 | 2.7 |
| 24 | 2.9 | 3.0 | 2.8 | 2.8 | 3.6 | 2.8 | 2.8 | 2.3 | 2.1 | 1.9 | 2.8 | 2.7 |
| 25 | 2.9 | 2.9 | 2.8 | 4.0 | 3.2 | 2.8 | 2.8 | 2.2 | 2.0 | 2.1 | 3.0 | 2.6 |
| 26 | 2.9 | 2.9 | 2.8 | 3.8 | 3.1 | 2.6 | 2.6 | 2.2 | 1.9 | 2.1 | 2.9 | 2.6 |
| 27 | 2.9 | 2.9 | 2.7 | 3.6 | 3.1 | 2.4 | 2.3 | 2.2 | 1.9 | 2.1 | 2.9 | 2.6 |
| 28 | 2.9 | 2.9 | 2.6 | 3.6 | 3.1 | 2.0 | 2.3 | 2.2 | 1.9 | 2.1 | 2.9 | 2.7 |
| 29 | 2.8 | ....... | 2.6 | 3.5 | 3.9 | 2.0 | 2.3 | 2.2 | 1.8 | 2.2 | 2.9 | 2.6 |
| 30 | 2.8 | ....... | 2.6 | 4.5 | 3.5 | 2.0 | 2.9 | 2.0 | 1.8 | 2.2 | 2.8 | 2.5 |
| 31 | 2.8 | ....... | 2.5 | ....... | 3.1 | ....... | 2.7 | 1.9 | ....... | 2.3 | ....... | 2.5 |

## NORTH FORK OF CANADIAN RIVER NEAR ELRENO, OKLA.

This station was established October 27, 1902, by W. G. Russell, and is located at the highway bridge 2 miles north of Elreno, Okla.

The channel both above and below the station is straight for about 200 feet and has a width of 130 feet at ordinary stage. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and somewhat shifting.

Discharge measurements are made from the bridge. The initial point for soundings is the end of the bridge on the right bank.

The original gage was of the wire type. It was destroyed July 6, 1903, but was reestablished July 10, 1903. June 5, 1905, a standard chain gage was fastened to the downstream railing of the bridge; length of chain, 17.46 feet. During 1905 the gage was read once each day by Austin Clift. The bench mark is the top of a steel cylinder pier on the north side of the bridge; elevation, 11.30 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 114; 99, p 244; 131, p 174.
Discharge: 84, p 114; 99, p 244; 131, p 174.
Discharge, monthly: 131, p 177.
Gage heights: 84, p 114; 99, p 244; 131, p 175.
Rating table: 131, p 176.

*Discharge measurements of North Fork of Canadian River near Elreno, Okla., in 1905.*

| Date. | Hydrographer. | Width. *Feet.* | Area of section. *Square feet.* | Mean velocity. *Feet per second.* | Gage height. *Feet.* | Discharge. *Second-feet.* |
|---|---|---|---|---|---|---|
| April 10 | E. R. Kerby | 106 | 194 | 2.18 | 3.80 | 423 |
| April 24 | Murphy and Kerby | 105 | 200 | 1.97 | 3.50 | 395 |
| April 25 | J. M. Giles | 105 | 187 | 1.64 | 3.55 | 307 |
| June 5 | do | 110 | 325 | 2.02 | 5.13 | 658 |
| June 17 | E. R. Kerby | 101 | 134 | 1.83 | 3.10 | 245 |
| July 1 | do | 100 | 128 | 1.59 | 2.90 | 204 |
| July 27 | J. M. Giles | 63 | 54 | 1.02 | 2.25 | 56 |
| August 23 | E. R. Kerby | 104 | 171 | 1.63 | 3.30 | 278 |
| August 23 | do | 104 | 171 | 1.58 | 3.25 | 270 |
| September 23 | do | 47 | 26 | .84 | 1.80 | 22 |
| September 26 | J. M. Giles | 24 | 17 | .71 | 1.70 | 12 |
| October 9 | E. R. Kerby | 22 | 8 | .50 | 1.50 | 4 |
| November 15 | do | ........ | 47 | 1.12 | 2.20 | 53 |
| December 11 | do | ........ | 97 | 1.32 | 2.70 | 128 |

*Daily gage height, in feet, of North Fork of Canadian River near Elreno, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.0 | ....... | 4.0 | 3.4 | 5.0 | 5.3 | 2.9 | 2.3 | 2.1 | 1.6 | 1.6 | 2.8 |
| 2 | 3.0 | ....... | 4.0 | 4.1 | 4.9 | 5.3 | 3.0 | 2.3 | 1.9 | 1.6 | 1.6 | 2.8 |
| 3 | 2.9 | ....... | 3.8 | 3.4 | 5.0 | 4.9 | 2.9 | 2.4 | 1.9 | 1.6 | 1.6 | 2.9 |
| 4 | 2.9 | ....... | 3.6 | 3.4 | 5.4 | 4.4 | 2.9 | 2.3 | 1.8 | 1.6 | 1.7 | 2.8 |
| 5 | 2.8 | ....... | 3.6 | 3.4 | 4.8 | 5.1 | 2.8 | 2.5 | 1.8 | 1.6 | 1.7 | 2.8 |
| 6 | 3.0 | ....... | 3.6 | 3.6 | 4.7 | 4.8 | 2.6 | 2.7 | 1.8 | 1.6 | 1.8 | 2.8 |
| 7 | 3.2 | ....... | 3.7 | 3.5 | 4.5 | 4.4 | 2.6 | 2.5 | 1.8 | 1.5 | 1.8 | 2.7 |
| 8 | 2.8 | ....... | 3.7 | 3.5 | 4.0 | 4.2 | 2.6 | 2.7 | 2.0 | 1.5 | 1.8 | 2.8 |
| 9 | ....... | ....... | 3.9 | 3.6 | 4.0 | 4.0 | 2.9 | 2.3 | 2.2 | 1.5 | 2.0 | 2.8 |
| 10 | ....... | ....... | 4.2 | 4.0 | 3.9 | 3.7 | 2.9 | 2.2 | 2.4 | 1.5 | 2.0 | 2.8 |
| 11 | ....... | ....... | 4.1 | 3.8 | 3.7 | 3.7 | 2.8 | 2.1 | 2.2 | 1.5 | 2.1 | 2.7 |
| 12 | ....... | ....... | 4.0 | 3.9 | 3.7 | 3.5 | 2.6 | 2.2 | 2.2 | 1.5 | 2.1 | 2.7 |
| 13 | ....... | ....... | 3.9 | 4.1 | 3.6 | 3.4 | 2.6 | 2.3 | 2.0 | 1.4 | 2.1 | 2.7 |
| 14 | ....... | ....... | 3.9 | 4.0 | 3.8 | 3.3 | 2.6 | 2.2 | 2.0 | 1.4 | 2.1 | 2.8 |
| 15 | ....... | ....... | 4.0 | 3.6 | 3.9 | 3.2 | 2.4 | 2.2 | 2.0 | 1.4 | 2.1 | 2.8 |
| 16 | ....... | ....... | 3.9 | 3.6 | 3.6 | 3.1 | 2.4 | 2.3 | 2.2 | 1.4 | 2.2 | 2.7 |
| 17 | ....... | ....... | 3.8 | 3.5 | 3.4 | 3.1 | 2.3 | 3.2 | 2.2 | 1.5 | 2.2 | 2.8 |
| 18 | ....... | ....... | 4.1 | 3.5 | 3.2 | 3.0 | 2.3 | 3.0 | 2.2 | 1.5 | 2.2 | 2.7 |
| 19 | ....... | ....... | 4.1 | 3.5 | 3.2 | 2.9 | 2.3 | 3.1 | 2.0 | 1.5 | 2.3 | 2.8 |
| 20 | ....... | ....... | 4.1 | 3.5 | 3.4 | 2.0 | 2.3 | 3.2 | 2.0 | 1.5 | 2.3 | 2.8 |
| 21 | ....... | ....... | 4.2 | 3.5 | 3.4 | 2.0 | 2.2 | 3.3 | 1.9 | 1.5 | 2.4 | 2.8 |
| 22 | ....... | ....... | 4.5 | 3.5 | 3.4 | 3.3 | 2.3 | 3.4 | 1.8 | 1.5 | 2.4 | 2.8 |
| 23 | ....... | ....... | 4.1 | 3.4 | 3.5 | 3.1 | 2.2 | 3.4 | 1.8 | 1.5 | 2.4 | 2.8 |
| 24 | ....... | 3.9 | 4.0 | 3.5 | 3.3 | 2.9 | 2.6 | 3.0 | 1.8 | 1.5 | 2.5 | 2.7 |
| 25 | ....... | 8.6 | 3.9 | 3.5 | 3.2 | 2.9 | 2.5 | 2.8 | 1.8 | 1.5 | 2.4 | 2.7 |
| 26 | ....... | 4.8 | 3.7 | 3.7 | 3.2 | 2.9 | 2.4 | 2.6 | 1.7 | 1.5 | 2.4 | 2.7 |
| 27 | ....... | 4.0 | 3.6 | 3.6 | 3.3 | 3.6 | 2.2 | 2.5 | 1.7 | 1.5 | 2.7 | 2.6 |
| 28 | ....... | 3.9 | 3.6 | 3.7 | 4.8 | 3.3 | 2.3 | 2.4 | 1.7 | 1.5 | 2.8 | 2.6 |
| 29 | ....... | ....... | 3.4 | 5.3 | 4.6 | 3.0 | 2.4 | 2.3 | 1.7 | 1.5 | 2.7 | 2.6 |
| 30 | ....... | ....... | 3.4 | 5.2 | 4.3 | 3.0 | 2.5 | 2.2 | 1.6 | 1.6 | 2.7 | 2.6 |
| 31 | ....... | ....... | 3.4 | ....... | 4.2 | ....... | 2.3 | 2.1 | ....... | 1.6 | ....... | 2.6 |

*Daily discharge, in second-feet, of North Fork of Canadian River near Elreno, Okla., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 515 | 370 | 650 | 710 | 187 | 67 | 43 | 11 | 11 | 164 |
| 2 | ....... | 515 | 535 | 625 | 710 | 210 | 67 | 26 | 11 | 11 | 164 |
| 3 | ....... | 464 | 370 | 650 | 615 | 187 | 82 | 26 | 11 | 11 | 187 |
| 4 | ....... | 415 | 370 | 740 | 490 | 187 | 67 | 20 | 11 | 15 | 164 |
| 5 | ....... | 415 | 370 | 600 | 650 | 164 | 99 | 20 | 11 | 15 | 164 |
| 6 | ....... | 415 | 415 | 575 | 580 | 119 | 141 | 20 | 11 | 20 | 164 |
| 7 | ....... | 440 | 395 | 530 | 490 | 119 | 99 | 20 | 8 | 20 | 141 |
| 8 | ....... | 440 | 395 | 410 | 450 | 119 | 141 | 34 | 8 | 20 | 164 |
| 9 | ....... | 490 | 415 | 410 | 410 | 187 | 67 | 54 | 8 | 34 | 164 |
| 10 | ....... | 560 | 515 | 385 | 340 | 187 | 54 | 82 | 8 | 34 | 164 |
| 11 | ....... | 535 | 464 | 330 | 345 | 164 | 43 | 54 | 8 | 43 | 141 |
| 12 | ....... | 515 | 490 | 330 | 300 | 119 | 54 | 54 | 8 | 43 | 141 |
| 13 | ....... | 490 | 535 | 310 | 280 | 119 | 67 | 34 | 6 | 43 | 141 |
| 14 | ....... | 490 | 515 | 360 | 270 | 119 | 54 | 34 | 6 | 43 | 164 |
| 15 | ....... | 515 | 415 | 390 | 255 | 82 | 54 | 34 | 6 | 43 | 164 |
| 16 | ....... | 490 | 415 | 305 | 240 | 82 | 67 | 54 | 6 | 54 | 141 |
| 17 | ....... | 464 | 395 | 260 | 245 | 67 | 256 | 54 | 8 | 54 | 164 |
| 18 | ....... | 535 | 395 | 220 | 210 | 67 | 210 | 54 | 8 | 54 | 141 |
| 19 | ....... | 535 | 395 | 220 | 187 | 67 | 233 | 34 | 8 | 67 | 164 |
| 20 | ....... | 535 | 395 | 260 | 34 | 67 | 256 | 34 | 8 | 67 | 164 |
| 21 | ....... | 560 | 395 | 260 | 34 | 54 | 279 | 26 | 8 | 82 | 164 |
| 22 | ....... | 630 | 395 | 260 | 279 | 67 | 302 | 20 | 8 | 82 | 164 |
| 23 | ....... | 535 | 370 | 280 | 233 | 54 | 302 | 20 | 8 | 82 | 164 |
| 24 | 490 | 515 | 395 | 240 | 187 | 119 | 210 | 20 | 8 | 99 | 141 |
| 25 | ....... | 490 | 307 | 215 | 187 | 99 | 164 | 20 | 8 | 82 | 141 |
| 26 | 720 | 440 | 340 | 215 | 187 | 82 | 119 | 15 | 8 | 82 | 141 |
| 27 | 515 | 415 | 320 | 240 | 350 | 54 | 99 | 15 | 8 | 141 | 119 |
| 28 | 490 | 415 | 340 | 590 | 279 | 67 | 82 | 15 | 8 | 164 | 119 |
| 29 | ....... | 370 | 720 | 540 | 210 | 82 | 67 | 15 | 8 | 141 | 119 |
| 30 | ....... | 370 | 700 | 470 | 210 | 99 | 54 | 11 | 11 | 141 | 119 |
| 31 | ....... | 370 | ....... | 450 | ....... | 67 | 43 | ....... | 11 | ....... | 119 |

NOTE.—From March 1 to June 17 the daily discharge was obtained by indirect method. For the remainder of the year a rating table based on measurements subsequent to June 17 was used.

*Estimated monthly discharge of North Fork of Canadian River near Elreno, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 630 | 370 | 480 | 29,510 |
| April | 720 | 307 | 428 | 25,470 |
| May | 740 | 215 | 397 | 24,410 |
| June | 710 | 34 | 332 | 19,760 |
| July | 210 | 54 | 112 | 6,887 |
| August | 302 | 43 | 126 | 7,747 |
| September | 82 | 11 | 32.1 | 1,910 |
| October | 11 | 6 | 8.5 | 522 |
| November | 164 | 11 | 59.9 | 3,564 |
| December | 187 | 119 | 151 | 9,285 |
| The period | ....... | ....... | ....... | 129,100 |

## RED RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The headwaters of Red River include several forks, all of which have their sources in northern Texas. Red River takes a general easterly direction along the northern boundary of Texas, and then turns toward the southeast and flows through a low, swampy region in Louisiana into the Mississippi not far from the southern boundary of the State of Mississippi.

North Fork and Salt Fork rise in the Panhandle of Texas and flow in a general southeasterly course across the southwest corner of Oklahoma, uniting with Prairie Dog Fork a short distance above Vernon, Tex. Elm Fork, rising in the same locality, joins North Fork 50 or 75 miles above its mouth. The flow is very uncertain, most of the run-off being flood water after heavy rains. The flow ceases entirely in the late summer and fall in ordinary dry years. The drainage area consists of dry, semiarid plains varied by sandhills in some portions. The underlying rocks are sandstone, limestone, and gypsum in the upper portion and granite where the streams pass through the Wichita Mountains.

Washita River rises in northern Texas, crosses southern Oklahoma, and flows into Red River in the southern part of Indian Territory, about 10 miles from Denison, Tex.

Sulphur Fork of Red River has its headwaters in Hunt and Fannin counties, Tex., flows eastward, forming the boundary between Delta, Red River, and Bowie counties on the north, and Hopkins, Franklin, Titus, Morris, and Cass counties on the south, and empties into Red River in Arkansas about 7 miles north of the Louisiana boundary line. The flow of this river is very unreliable, changing with the rainfall. If the summer is at all dry it ceases altogether, but enough water always remains standing in pools to water stock. During or immediately after protracted or unusually heavy rains the river becomes very wide and deep, floods its bottoms, and often occasions considerable loss of stock and damage to planters and the railroads.

Big Cypress Creek has its headwaters in Franklin and Titus counties, Tex., flows in a general easterly direction, and empties into Red River. The flow of the river is unreliable, varying with the rainfall. In the summer it ceases and the river becomes dry except where the water stands in holes. After long or heavy rains the stream is liable to overflow its banks.

### RED RIVER AT ARTHUR CITY, TEX.

This station was established January 1, 1905. The United States Weather Bureau had maintained a gaging station at this point since 1891.

The gage is a vertical staff fastened to one of the piers of the bridge. During 1905 the gage was read by Mrs. Mary Tunnell. Bench marks were established as follows: (1) The base of rail on the bridge above the second section of the Weather Bureau gage; elevation, 411.10 feet above mean sea level, and 48.00 feet above the datum of the gage. (2) A rock with a 12-foot square surface, lying in the river about 300 feet southeast of the railway bridge; elevation, 363.40 feet above mean sea level and 0.30 foot above the datum of the gage.

*Discharge measurements of Red River at Arthur City, Tex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second* | *Feet* | *Second-feet.* |
| March 17 | H. H. Fox | 290 | 1,995 | 2.10 | 7.6 | 4,200 |
| March 18 | do | 506 | 3,830 | 3.67 | 11.0 | 13,080 |

*Daily gage height, in feet, of Red River at Arthur City, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.3 | 4.5 | 8.0 | 9.2 | 12.4 | 23.3 | 9.2 | 13.7 | 6.7 | 6.0 | 6.7 | 9.3 |
| 2 | 4.3 | 4.5 | 8.0 | 10.0 | 10.8 | 22.0 | 8.5 | 13.5 | 6.7 | 6.0 | 6.3 | 9.9 |
| 3 | 4.2 | 4.5 | 8.0 | 14.5 | 10.0 | 21.0 | 8.0 | 13.0 | 6.0 | 14.5 | 6.0 | 9.3 |
| 4 | 4.2 | 4.5 | 7.6 | 14.8 | 9.5 | 19.5 | 10.5 | 12.5 | 5.9 | 12.1 | 6.0 | 9.0 |
| 5 | 4.2 | 4.5 | 6.3 | 14.6 | 9.5 | 18.0 | 10.8 | 9.2 | 5.7 | 11.0 | 5.8 | 8.8 |
| 6 | 4.2 | 4.5 | 6.3 | 14.4 | 9.0 | 17.0 | 12.0 | 9.0 | 5.7 | 10.2 | 5.6 | 8.5 |
| 7 | 4.2 | 4.5 | 6.3 | 14.0 | 9.0 | 15.0 | 12.5 | 8.8 | 5.7 | 9.8 | 9.5 | 8.3 |
| 8 | 4.2 | 4.5 | 7.5 | 11.4 | 9.5 | 13.2 | 12.5 | 8.2 | 5.5 | 7.8 | 7.8 | 8.3 |
| 9 | 4.2 | 4.5 | 8.9 | 10.4 | 9.2 | 12.0 | 19.5 | 8.0 | 5.5 | 7.1 | 7.2 | 7.7 |
| 10 | 4.2 | 4.5 | 8.9 | 9.5 | 9.0 | 11.5 | 17.5 | 8.0 | 5.5 | 6.6 | 12.9 | 7.0 |
| 11 | 4.8 | 4.5 | 8.9 | 9.0 | 9.0 | 10.4 | 14.5 | 7.4 | 5.6 | 6.6 | 12.7 | 6.8 |
| 12 | 4.8 | 4.5 | 9.5 | 9.0 | 8.2 | 10.0 | 12.0 | 7.0 | 6.0 | 6.2 | 12.0 | 6.6 |
| 13 | 4.8 | 4.5 | 9.0 | 8.0 | 8.2 | 9.8 | 11.0 | 8.0 | 11.6 | 6.2 | 11.4 | 6.5 |
| 14 | 4.8 | 4.5 | 8.0 | 7.6 | 14.0 | 11.0 | 10.5 | 8.0 | 13.3 | 6.0 | 10.0 | 12.2 |
| 15 | 5.3 | 4.5 | 9.4 | 7.6 | 14.4 | 10.5 | 10.5 | 8.0 | 11.5 | 6.0 | 11.7 | 17.2 |
| 16 | 5.3 | 4.5 | 9.4 | 8.4 | 15.6 | 10.0 | 10.5 | 8.0 | 10.7 | 6.0 | 11.7 | 13.6 |
| 17 | 5.3 | 4.5 | 7.6 | 8.4 | 15.0 | 9.6 | 10.2 | 9.8 | 10.4 | 6.0 | 11.2 | 12.0 |
| 18 | 5.3 | 4.5 | 10.8 | 8.4 | 14.0 | 9.0 | 10.2 | 9.8 | 9.8 | 6.0 | 10.0 | 12.4 |
| 19 | 5.6 | 4.6 | 13.0 | 10.0 | 12.5 | 8.8 | 10.7 | 9.5 | 9.5 | 10.0 | 8.7 | 11.4 |
| 20 | 5.9 | 4.8 | 14.5 | 9.6 | 10.5 | 9.6 | 10.7 | 8.4 | 8.8 | 12.2 | 9.2 | 9.5 |
| 21 | 5.9 | 4.8 | 15.5 | 9.6 | 16.0 | 12.0 | 11.0 | 9.0 | 8.2 | 8.5 | 8.0 | 15.0 |
| 22 | 5.0 | 6.8 | 15.0 | 9.0 | 19.4 | 12.5 | 11.3 | 8.8 | 8.0 | 7.0 | 7.8 | 14.0 |
| 23 | 4.5 | 6.8 | 11.7 | 9.3 | 21.2 | 12.5 | 13.2 | 8.6 | 7.8 | 7.0 | 7.8 | 13.4 |
| 24 | 4.5 | 7.6 | 10.3 | 9.6 | 18.4 | 11.4 | 14.0 | 8.2 | 7.8 | 6.8 | 7.4 | 12.0 |
| 25 | 4.5 | 9.0 | 9.6 | 14.8 | 21.6 | 11.4 | 14.2 | 8.0 | 7.6 | 9.9 | 9.0 | 11.6 |
| 26 | 4.5 | 8.7 | 9.2 | 15.8 | 21.0 | 11.0 | 13.7 | 7.7 | 7.1 | 9.2 | 9.0 | 11.3 |
| 27 | 4.5 | 8.4 | 8.7 | 15.8 | 18.0 | 9.5 | 13.7 | 7.6 | 7.0 | 8.0 | 9.0 | 9.0 |
| 28 | 4.5 | 8.0 | 9.0 | 17.0 | 20.5 | 9.8 | 13.7 | 7.4 | 6.0 | 7.0 | 9.0 | 8.8 |
| 29 | 4.5 | ....... | 11.0 | 17.4 | 19.5 | 9.8 | 13.7 | 7.0 | 6.5 | 6.9 | 8.8 | 8.8 |
| 30 | 4.5 | ....... | 10.2 | 13.7 | 22.0 | 9.8 | 13.7 | 7.0 | 6.2 | 6.7 | 8.2 | 8.8 |
| 31 | 4.5 | ....... | 9.9 | ....... | 25.0 | ....... | 13.7 | 6.7 | ....... | 6.7 | ....... | 8.1 |

## NORTH FORK OF RED RIVER NEAR GRANITE, OKLA.

This station was established June 23, 1903, by Fred Bonstedt. It is located at the highway bridge 2 miles east and one-half mile north of Granite, Okla. The Chicago, Rock Island and Pacific Railway crosses the river near this point.

The channel is straight for about 500 feet above the station and about 300 feet below. Both banks are subject to overflow at flood stages. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge.

The original wire gage was replaced December 5, 1905, by a standard chain gage bolted to the fencing on the upstream side of the bridge, 48 feet from the west end. Length of chain, 21.16 feet. During 1905 the gage was read once each day by Elmer O. Tompkins. The bench mark is a United States Geological Survey standard iron post set 292 feet east of the bridge, near the south line of the highway; elevation, 10.64 feet above the datum of the gage and 1,539.8 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 319; 131, pp 182-183.
Discharge: 99, p 319; 131, p 183.
Gage heights: 99, p 320; 131, p 183.

*Discharge measurements of North Fork of Red River near Granite, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 24 | E. R. Kerby | 192 | 391 | 3.23 | 6.50 | 1,265 |
| April 12 | do | 32 | 34 | .86 | 5.40 | 30 |
| April 26 | Murphy and Kerby | 268 | 784 | 4.26 | 7.35 | 3,340 |
| April 26 | J. M. Giles | 326 | 1,225 | 4.39 | 8.00 | 5,379 |
| May 23 | E. R. Kerby | 101 | 134 | 1.99 | 6.10 | 266 |
| May 24 | J. M. Giles | 87 | 76 | 1.90 | 5.80 | 144 |
| June 9 | E. R. Kerby | 100 | 138 | 2.98 | 6.30 | 410 |
| July 2 | do | 30 | 15 | .82 | 5.50 | 12 |
| July 11 | do | 12 | 11 | .58 | 5.40 | 6.4 |
| August 24 | do | 23 | 13 | 1.14 | 5.50 | 15 |
| August 25 | J. M. Giles | 16 | 9.8 | 1.29 | 5.45 | 12.6 |
| September 24 | do | 14 | 4.6 | .59 | 5.20 | 2.7 |
| September 27 | E. R. Kerby | 2.5 | .5 | 1.00 | 5.10 | .5 |
| November 29 | do | | 86 | 1.62 | 6.10 | 139 |
| December 5 | do | | 53 | 1.65 | 5.75 | 87 |
| December 19 | do | | 45 | 1.59 | 6.05 | 72 |
| ([a]) | J. M. Giles | | 2,916 | 6.24 | 11.50 | 18,200 |
| ([a]) | do | | 2,100 | 5.11 | 9.50 | 10,730 |
| ([a]) | do | | 650 | 2.32 | 8.00 | 1,508 |
| ([a]) | do | | 240 | 1.58 | 7.00 | 380 |

[a] Computed from slope measurement, using Kutter's formula.

*Daily gage height, in feet, of North Fork of Red River near Granite, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | ...... | 5.4 | 5.2 | 6.0 | 6.8 | 5.6 | 5.6 | 5.2 | 4.9 | 4.9 | 5.9 |
| 2 | ...... | ...... | 5.4 | 5.3 | 6.0 | ...... | 5.5 | 5.5 | 5.1 | 5.0 | 4.9 | 5.9 |
| 3 | ...... | ...... | 5.3 | 5.3 | 5.9 | ...... | 5.5 | 5.5 | 5.1 | 5.0 | 4.9 | 5.85 |
| 4 | ...... | ...... | 5.2 | 5.4 | 5.7 | 6.1 | 5.5 | 6.0 | 5.1 | 4.95 | 4.9 | 5.8 |
| 5 | ...... | ...... | 5.3 | 6.2 | 5.5 | 6.0 | 5.5 | 5.7 | 5.0 | 4.9 | 4.9 | 5.75 |
| 6 | ...... | ...... | 5.9 | 5.9 | 5.3 | 5.9 | 5.5 | 5.8 | 5.4 | 4.9 | 4.9 | 5.85 |
| 7 | ...... | ...... | 5.5 | 5.8 | 5.3 | 6.4 | 5.4 | 5.9 | 5.2 | 4.9 | 4.9 | 5.85 |
| 8 | ...... | ...... | 5.4 | 5.8 | 5.8 | 6.2 | 5.4 | 6.0 | 8.5 | 4.9 | 4.9 | 5.85 |
| 9 | ...... | ...... | 5.6 | 5.8 | 6.5 | 6.4 | 5.4 | 6.1 | 7.6 | 4.9 | ...... | 5.8 |
| 10 | ...... | ...... | 5.9 | 6.3 | 6.1 | 6.2 | 5.4 | 6.2 | 7.5 | 4.9 | 6.0 | 5.8 |
| 11 | ...... | ...... | 5.7 | 6.1 | 5.9 | 6.2 | 5.3 | 5.8 | 6.4 | 4.9 | 6.8 | 5.85 |
| 12 | ...... | ...... | 5.6 | 5.8 | 5.7 | 6.1 | 5.3 | 6.0 | 6.0 | 4.9 | 6.1 | 5.85 |
| 13 | ...... | ...... | 5.6 | 5.6 | 5.6 | 6.0 | 5.3 | 7.8 | 6.0 | 4.9 | 6.05 | 6.0 |
| 14 | ...... | ...... | 5.6 | 5.4 | 5.5 | 6.1 | 5.3 | 7.0 | 6.05 | 4.9 | 6.0 | 6.05 |
| 15 | ...... | ...... | 5.7 | 5.4 | 5.4 | 6.0 | 5.3 | 6.8 | 5.9 | 4.9 | 6.0 | 6.4 |
| 16 | ...... | ...... | 5.9 | 5.4 | 5.7 | 5.9 | 5.4 | 6.5 | 5.65 | 4.9 | 5.95 | 6.15 |
| 17 | ...... | ...... | 7.7 | 5.3 | 5.4 | 5.9 | 5.4 | 6.2 | 5.5 | 4.9 | 5.85 | 6.1 |
| 18 | ...... | ...... | 6.5 | 5.3 | 5.3 | 5.8 | 5.4 | ...... | 5.5 | 4.9 | 5.8 | 6.1 |
| 19 | ...... | ...... | 6.3 | 5.3 | 5.3 | 5.9 | 5.4 | ...... | 5.45 | 4.9 | ...... | 6.05 |
| 20 | ...... | ...... | 6.2 | 5.7 | 5.7 | 5.8 | 5.3 | 6.1 | 5.6 | 4.9 | 5.7 | 6.05 |
| 21 | ...... | ...... | 5.9 | 5.6 | 5.8 | 5.8 | 5.5 | 6.0 | 5.4 | 4.9 | 5.7 | 6.0 |
| 22 | ...... | ...... | 5.7 | 5.6 | 6.1 | 5.7 | 6.1 | 5.8 | 5.3 | 4.9 | 5.75 | 6.1 |
| 23 | ...... | 8.1 | 5.6 | 5.8 | 6.0 | 5.6 | 5.9 | 5.6 | 5.2 | 4.9 | 5.8 | 6.15 |
| 24 | 5.0 | 6.5 | 5.4 | 6.2 | 5.8 | 5.6 | 5.6 | 5.5 | 5.2 | 4.9 | 8.85 | ...... |
| 25 | 5.6 | 5.8 | 5.2 | 8.3 | 5.9 | ...... | 5.5 | 5.5 | 5.2 | 4.9 | 7.5 | ...... |
| 26 | 5.5 | 5.5 | 5.5 | 8.1 | 6.0 | 5.8 | 5.4 | 5.4 | 5.2 | 4.9 | 6.4 | 6.25 |
| 27 | 5.5 | 5.3 | 5.5 | 6.6 | 9.9 | 5.7 | 5.4 | 5.4 | 5.1 | 4.9 | 6.2 | 6.1 |
| 28 | 5.3 | 5.6 | 5.5 | 6.3 | 10.2 | 5.7 | 5.5 | 5.4 | 5.05 | 4.9 | 6.0 | 6.1 |
| 29 | 5.3 | ...... | 5.3 | 6.0 | 7.4 | 5.6 | 5.6 | 5.4 | 5.0 | 4.9 | 5.9 | 6.1 |
| 30 | 5.5 | ...... | 5.2 | 5.9 | 6.8 | 5.6 | 5.9 | 5.3 | 4.95 | 5.0 | 5.9 | 6.1 |
| 31 | 5.4 | ...... | 5.1 | ...... | 7.0 | ...... | 5.7 | 5.3 | ...... | 4.95 | ...... | ...... |

## NORTH FORK OF RED RIVER NEAR SNYDER, OKLA.

This station was established April 14, 1905, and was discontinued July 31, 1905. It is located at the Frisco Railway bridge about 8 miles west of Snyder, Okla.

The channel is straight for 300 feet above and 1,000 feet below the station. The current is swift. The right bank is low and sandy, and overflows only under the railway trestle. The left bank is high and rocky and is not subject to overflow. The bed of the stream is composed of sand and is free from vegetation and shifting. There is but one channel, broken only by the pile bents, which are very close together, catching large quantities of drift during floods and making the current varying and uncertain.

Discharge measurements are made from the upstream side of the railroad bridge on trestle bents 14 feet apart. The initial point for soundings is the end of the upstream guard rail at the right bank.

A standard chain gage is attached to the downstream guard rail of the bridge; length of the chain, 18.65 feet. There are also two short sections of vertical gage fastened to the piles of the bridge. During 1905 the gage was read once each day by D. M. Deason. The bench mark is a cross on a rock on the left bank, 200 feet above the bridge; elevation, 7.04 feet above the datum of the gage.

*Discharge measurements of North Fork of Red River near Snyder, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 14 | E. R. Kerby | 106 | 183 | 0.88 | 2.40 | 161 |
| April 14 | J. M. Giles | 477 | 1,603 | 1.90 | 4.05 | 3,045 |
| May 19 | E. R. Kerby | 182 | 224 | .63 | 2.40 | 142 |
| May 21 | J. M. Giles | 340 | 691 | 1.47 | 3.25 | 1,017 |
| May 22 | do | 399 | 862 | 1.90 | 3.71 | 1,639 |
| May 25 | E. R. Kerby | 162 | 330 | 1.78 | 2.90 | 589 |
| May 30 | do | 357 | 2,203 | 3.43 | 4.15 | 7,546 |
| June 1 | J. M. Giles | 480 | 1,978 | 1.58 | 4.35 | 3,121 |
| June 13 | E. R. Kerby | 220 | 308 | 1.52 | 2.37 | 469 |
| June 27 | do | 141 | 189 | 1.28 | 1.90 | 242 |
| July 6 | do | 130 | 140 | .81 | 1.50 | 113 |
| July 7 | do | 131 | 146 | .83 | 1.55 | 122 |
| July 13 | do | 130 | 138 | .94 | 1.65 | 130 |
| July 14 | do | 130 | 136 | .91 | 1.60 | 124 |
| July 16 | J. M. Giles | 128 | 116 | .69 | 1.50 | 80 |
| July 20 | do | 125 | 99 | .61 | 1.40 | 61 |
| July 25 | E. R. Kerby | 145 | 200 | 1.48 | 2.00 | 296 |

*Daily gage height, in feet, of North Fork of Red River near Snyder, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Day. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.8 | 4.2 | 1.9 | 17 | 2.3 | | 2.2 | 1.5 |
| 2 | | 2.7 | 3.9 | 1.9 | 18 | 2.4 | | 2.0 | 1.5 |
| 3 | | | 3.2 | 1.9 | 19 | 2.4 | 2.4 | 2.0 | 1.5 |
| 4 | | | 2.8 | 1.8 | 20 | 2.3 | 2.7 | 1.9 | 1.4 |
| 5 | | | 2.7 | 1.7 | 21 | 2.7 | 3.2 | 1.9 | 1.4 |
| 6 | | | 2.6 | 1.6 | 22 | 2.6 | 3.9 | 1.9 | 2.1 |
| 7 | | | 3.2 | 1.6 | 23 | 3.2 | 3.5 | 3.2 | 2.4 |
| 8 | | | 3.9 | 1.6 | 24 | 3.2 | 3.3 | 2.5 | 2.0 |
| 9 | | | 3.8 | 1.7 | 25 | 4.9 | 2.9 | 2.1 | 1.9 |
| 10 | | | 3.2 | 1.6 | 26 | 4.1 | 2.5 | 2.0 | 1.9 |
| 11 | | | 2.6 | 1.7 | 27 | 4.1 | 6.9 | 1.9 | 1.8 |
| 12 | | 4.3 | 2.5 | 1.6 | 28 | 3.5 | 6.6 | 1.9 | 1.7 |
| 13 | | 4.5 | 2.4 | 1.5 | 29 | 3.2 | 5.0 | 1.8 | 1.6 |
| 14 | 2.4 | | 2.4 | 1.5 | 30 | 3.1 | 4.2 | 1.9 | 1.5 |
| 15 | 2.3 | | 2.3 | 1.5 | 31 | | 4.5 | | 1.2 |
| 16 | 2.3 | | 2.2 | 1.5 | | | | | |

## NORTH FORK OF RED RIVER NEAR HEADRICK, OKLA.

This station was established July 17, 1905. It is located at the Navajo dam site, about 4 miles northeast of Headrick and 8 miles west of Mountain Park, Okla.

The channel is straight for 200 feet above and 1,000 feet below the station. Both banks are high and clean and will not overflow. The bed of the stream is composed of sand and is shifting. There is but one channel at all except very low stages.

Discharge measurements are made by means of a cable and car about 100 yards above the gage. The initial point for soundings is a paint mark on the cable near the right end.

An inclined staff gage is fastened to the rock on the right bank. Above 6 feet the gage is painted on the rock. During 1905 the gage was read once each day by John Graves. The bench mark is a cross cut in the rock about 10 feet south of the gage; elevation, 8.40 feet above the datum of the gage.

*Discharge measurements of North Fork of Red River near Headrick, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 17 | J. M. Giles | 49 | 67 | 1.00 | 2.00 | 67 |
| July 19 | do | 74 | 108 | .54 | 1.95 | 58 |
| July 19 | E. R. Kerby | 54 | 59 | .92 | 1.95 | 54 |
| July 20 | J. M. Giles | 36 | 47 | 1.06 | 1.92 | 50 |
| July 25 | E. R. Kerby | 175 | 309 | 2.47 | 3.10 | 764 |
| July 26 | do | 121 | 202 | 1.50 | 2.70 | 303 |
| July 26 | do | 118 | 191 | 1.46 | 2.60 | 278 |
| August 2 | do | 54 | 103 | 1.18 | 2.20 | 122 |
| August 2 | do | 53 | 96 | 1.25 | 2.10 | 120 |
| August 9 | do | 52 | 83 | 1.10 | 2.10 | 91 |
| August 9 | do | 52 | 86 | 1.38 | 2.15 | 119 |
| August 14 | do | 200 | 619 | 3.84 | 4.25 | 2,380 |
| August 15 | do | 200 | 611 | 3.56 | 4.20 | 2,174 |
| August 15 | do | 200 | 600 | 3.54 | 4.25 | 2,126 |
| August 15 | do | 200 | 618 | 3.18 | 4.22 | 1,965 |
| August 16 | do | 190 | 443 | 2.16 | 3.72 | 960 |
| August 19 | do | 80 | 295 | 1.43 | 3.30 | 422 |
| August 26 | do | 95 | 71 | 1.18 | 2.25 | 84 |
| August 30 | do | 70 | 58 | 1.09 | 2.10 | 63 |
| September 5 | do | 27 | 41 | .61 | 1.90 | 25 |
| September 13 | do | 86 | 318 | 1.16 | 3.10 | 368 |
| September 13 | do | 86 | 310 | 1.08 | 3.00 | 335 |
| September 18 | do | 83 | 259 | .53 | 2.50 | 133 |
| September 20 | do | 83 | 274 | .71 | 2.75 | 196 |
| September 20 | do | 83 | 266 | .62 | 2.65 | 165 |
| September 21 | J. M. Giles | 84 | 259 | .48 | 2.60 | 125 |
| September 29 | E. R. Kerby | 26 | 81 | .55 | 2.20 | 44 |
| October 4 | do | 26 | 82 | .56 | 2.20 | 46 |
| October 4 | do | 26 | 82 | .59 | 2.20 | 48 |
| October 13 | do | 29 | 16 | 1.32 | 2.10 | 21 |
| October 22 | do | 30 | 20 | 1.25 | 2.10 | 25 |
| October 27 | do | 20 | 20 | 1.10 | 2.10 | 22 |
| November 11 | do | | 389 | 2.78 | 3.80 | 1,082 |
| November 13 | do | | 241 | 1.13 | 3.00 | 272 |
| November 24 | do | | 222 | 1.30 | 2.80 | 288 |
| November 27 | do | | 373 | 1.38 | 3.20 | 514 |
| December 8 | J. M. Giles | | 306 | .40 | 2.60 | 121 |
| December 16 | E. R. Kerby | | 314 | .99 | 3.00 | 312 |
| December 22 | do | | 264 | .86 | 2.85 | 226 |
| December 27 | do | | 255 | .78 | 2.70 | 198 |

*Daily gage height, in feet, of North Fork of Red River near Headrick, Okla., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.8 | 2.0 | 2.2 | 2.1 | 2.6 | 17 | ...... | 3.2 | 2.6 | 2.1 | 2.7 | 2.7 |
| 2 | ...... | 2.5 | 2.0 | 2.2 | 2.1 | 2.6 | 18 | 2.0 | 3.0 | 2.5 | 2.1 | 2.7 | 2.7 |
| 3 | ...... | 2.3 | 1.9 | 2.2 | 2.1 | 2.6 | 19 | 2.0 | 3.5 | 2.4 | 2.1 | 2.5 | 2.6 |
| 4 | ...... | 2.1 | 1.9 | 2.2 | 2.1 | 2.6 | 20 | 1.9 | 3.0 | 2.6 | 2.1 | 2.4 | 2.6 |
| 5 | .... | 2.1 | 2.1 | 2.2 | 3.0 | 2.6 | 21 | 1.8 | 2.8 | 2.7 | 2.1 | 2.4 | 2.6 |
| 6 | ...... | 2.8 | 2.2 | 2.2 | 2.5 | 2.6 | 22 | 2.5 | 2.7 | 2.5 | 2.1 | 2.4 | 2.6 |
| 7 | ...... | 2.4 | 2.2 | 2.2 | 2.3 | 2.6 | 23 | 3.0 | 2.5 | 2.5 | 2.1 | 2.4 | 2.6 |
| 8 | ...... | 2.8 | 2.3 | 2.1 | 2.5 | 2.6 | 24 | 2.6 | 2.4 | 2.5 | 2.1 | 2.8 | 2.6 |
| 9 | ...... | 2.3 | 3.6 | 2.1 | 3.0 | 2.6 | 25 | 2.5 | 2.3 | 2.3 | 2.1 | 3.8 | 2.6 |
| 10 | ...... | 2.1 | 4.45 | 2.1 | 3.1 | 2.6 | 26 | 2.8 | 2.2 | 2.3 | 2.1 | 2.6 | 2.6 |
| 11 | ...... | 2.1 | 3.7 | 2.1 | 3.8 | 2.5 | 27 | 2.4 | 2.0 | 2.2 | 2.1 | 3.2 | 2.7 |
| 12 | ...... | 2.2 | 3.5 | 2.1 | 3.1 | 2.5 | 28 | 2.3 | 2.0 | 2.2 | 2.1 | 2.2 | 2.7 |
| 13 | ...... | 2.6 | 3.1 | 2.1 | 3.1 | 2.7 | 29 | 2.3 | 2.0 | 2.2 | 2.1 | 2.6 | 2.6 |
| 14 | ...... | 4.6 | 2.9 | 2.1 | 2.8 | 2.7 | 30 | 2.4 | 1.9 | 2.2 | 2.1 | 2.6 | 2.6 |
| 15 | ...... | 4.2 | 2.8 | 2.1 | 2.7 | 2.7 | 31 | 2.8 | 2.0 | ...... | 2.1 | ...... | 2.6 |
| 16 | ...... | 3.7 | 2.7 | 2.1 | 2.7 | 3.0 | | | | | | | |

*Daily discharge, in second-feet, of North Fork of Red River near Headrick, Okla., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 425 | 50 | 46 | 25 | 190 | 17 | ...... | 430 | 150 | 24 | 240 | 230 |
| 2 | ...... | 220 | 50 | 46 | 26 | 180 | 18 | 67 | 300 | 130 | 24 | 240 | 230 |
| 3 | ...... | 140 | 30 | 46 | 26 | 170 | 19 | 67 | 720 | 110 | 24 | 160 | 200 |
| 4 | ...... | 80 | 25 | 46 | 26 | 160 | 20 | 50 | 300 | 150 | 24 | 125 | 200 |
| 5 | ...... | 80 | 60 | 43 | 340 | 150 | 21 | 35 | 190 | 175 | 24 | 125 | 200 |
| 6 | ...... | 425 | 75 | 40 | 125 | 140 | 22 | 220 | 155 | 130 | 24 | 125 | 200 |
| 7 | ...... | 180 | 75 | 37 | 75 | 130 | 23 | 630 | 115 | 130 | 24 | 125 | 200 |
| 8 | ...... | 425 | 90 | 31 | 125 | 120 | 24 | 275 | 100 | 130 | 24 | 290 | 190 |
| 9 | ...... | 140 | 840 | 31 | 340 | 120 | 25 | 220 | 85 | 75 | 24 | 1,080 | 180 |
| 10 | ...... | 95 | 3,300 | 27 | 150 | 120 | 26 | 425 | 75 | 75 | 24 | 200 | 180 |
| 11 | ...... | 95 | 975 | 24 | 1,080 | 100 | 27 | 180 | 65 | 50 | 24 | 515 | 190 |
| 12 | ...... | 110 | 720 | 21 | 360 | 100 | 28 | 140 | 65 | 45 | 24 | 75 | 190 |
| 13 | ...... | 275 | 370 | 21 | 360 | 170 | 29 | 140 | 65 | 45 | 24 | 200 | 170 |
| 14 | ...... | 4,900 | 270 | 21 | 290 | 170 | 30 | 180 | 62 | 45 | 24 | 200 | 170 |
| 15 | ...... | 2,050 | 220 | 24 | 240 | 170 | 31 | 425 | 65 | ...... | 24 | ...... | 170 |
| 16 | ...... | 970 | 175 | 24 | 240 | 320 | | | | | | | |

NOTE.—On account of shifting conditions, the daily discharge has been computed from several rating tables, each covering a short period of time.

*Estimated monthly discharge of North Fork of Red River near Headrick, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| July 18-31 | 630 | 35 | 218 | 6,054 |
| August | 4,900 | 62 | 432 | 26,560 |
| September | 3,300 | 25 | 292 | 17,380 |
| October | 46 | 21 | 28.6 | 1,758 |
| November | 1,080 | 25 | 251 | 14,940 |
| December | 320 | 100 | 175 | 10,760 |
| The period | .......... | .......... | .......... | 77,450 |

## ELM FORK OF RED RIVER NEAR MANGUM, OKLA.

This station was established April 12, 1905. It is located on the highway bridge about 4 miles north of Mangum, Okla.

The channel is straight for about 500 feet above and 200 feet below the bridge. The current is swift. Both banks are low and liable to overflow. The bed of the stream is composed of sand and is shifting. There is but one channel, broken by the pile bents of the bridge, which catch and hold drift badly during high water.

Discharge measurements are made from the upstream side of the pile bent bridge. The initial point for soundings is at the north end of the bridge.

A standard chain gage is fastened to the bridge; length of chain, 24.58 feet. During 1905 the gage was read once each day by E. R. Pierson. Bench marks were established as follows: (1) An iron pin driven flush with the surface 59 feet south and 7 feet west of the south end of the bridge; elevation, 14.30 feet (2) A paint mark on the top of the bridge cap 10 feet south of the gage; elevation, 18.46 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Elm Fork of Red River near Mangum, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 12 | E. R. Kerby | 40 | 18 | 0.72 | 2.00 | 13 |
| April 26 | Murphy and Kerby | 190 | 248 | 1.96 | 3.56 | 487 |
| May 23 | E. R. Kerby | 130 | 105 | 1.46 | 2.90 | 153 |
| May 25 | J. M. Giles | 242 | 589 | 2.28 | 4.70 | 1,346 |
| May 25 | do | 143 | 145 | 1.26 | 2.90 | 183 |
| May 26 | do | 151 | 167 | 1.55 | 3.30 | 259 |
| May 26 | do | 226 | 321 | 1.84 | 3.88 | 592 |
| May 27 | do | 310 | 1,404 | 4.74 | 8.35 | 6,648 |
| May 27 | do | 312 | 1,722 | 5.38 | 9.30 | 9,271 |
| June 22 | E. R. Kerby | 276 | 581 | 3.08 | 5.40 | 1,791 |
| July 2 | do | 53 | 34 | 1.48 | 2.60 | 49 |
| July 11 | do | 62 | 52 | 1.46 | 2.80 | 76 |
| July 11 | do | 62 | 46 | 1.40 | 2.70 | 64 |
| July 25 | J. M. Giles | 98 | 102 | 1.53 | 3.16 | 156 |
| August 24 | E. R. Kerby | 53 | 21 | 1.15 | 2.40 | 24 |
| September 24 | J. M. Giles | 42 | 16 | .87 | 2.30 | 14 |
| September 27 | E. R. Kerby | 32 | 14 | 1.14 | 2.30 | 16 |
| October 25 | do | 32 | 14 | 1.17 | 2.30 | 16 |
| November 29 | do | | 33 | 1.33 | 2.40 | 44 |
| December 5 | do | | 35 | 1.20 | 2.30 | 43 |
| December 19 | do | | 24 | 1.09 | 2.40 | 26 |
| (a) | J. M. Giles | | 893 | 2.43 | 5.40 | 2,175 |
| (a) | do | | 3,000 | 480 | 11.50 | 14,400 |

[a] Computed from slope measurement, using Kutter's formula.

*Daily gage height, in feet, of Elm Fork of Red River near Mangum, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.4 | 3.7 | 2.6 | 2.5 | 2.3 | 2.2 | 2.4 | 2.3 |
| 2 | | 2.3 | 3.2 | 2.6 | 2.5 | 2.3 | 2.2 | 2.3 | 2.3 |
| 3 | | 2.2 | 3.2 | 2.6 | 2.5 | 2.3 | 2.2 | 2.3 | 2.3 |
| 4 | | 2.2 | 3.0 | 2.6 | 3.0 | 2.3 | 2.2 | 2.3 | 2.4 |
| 5 | | 2.2 | 3.0 | 2.6 | 2.6 | 2.3 | 2.3 | 3.0 | 2.3 |
| 6 | | 2.2 | 2.9 | 2.5 | 2.5 | 2.4 | 2.3 | 2.6 | 2.3 |
| 7 | | 2.3 | 5.9 | 2.5 | 2.7 | 2.4 | 2.3 | 2.7 | 2.3 |
| 8 | | 2.3 | 4.5 | 2.5 | 3.1 | 2.4 | 2.3 | 2.6 | 2.3 |
| 9 | | 2.3 | 3.5 | 2.5 | 2.6 | 3.0 | 2.3 | 4.2 | 2.3 |
| 10 | | 2.5 | 3.0 | 2.7 | 2.5 | 3.4 | 2.3 | 4.4 | 2.3 |
| 11 | | 2.3 | 3.0 | 2.7 | 2.5 | 2.8 | 2.3 | 2.9 | 2.3 |
| 12 | 2.0 | 2.3 | 2.9 | 2.6 | 2.4 | 2.5 | 2.3 | 2.7 | 2.3 |
| 13 | 2.0 | 3.5 | 2.8 | 2.5 | 3.9 | 2.5 | 2.2 | 2.5 | 2.9 |
| 14 | 1.9 | 3.2 | 2.9 | 2.5 | 4.8 | 2.5 | 2.2 | 2.4 | 2.8 |
| 15 | 1.8 | 2.5 | 2.8 | 2.5 | 3.2 | 2.4 | 2.2 | 2.4 | 2.5 |
| 16 | 1.9 | 2.2 | 2.8 | 2.5 | 2.8 | 2.4 | 2.2 | 2.4 | 2.4 |
| 17 | 2.0 | 2.1 | 2.7 | 2.4 | 2.7 | 2.3 | 2.3 | 2.4 | 2.4 |
| 18 | 2.2 | 2.0 | 2.7 | 2.4 | 2.6 | 2.3 | 2.3 | 2.3 | 2.4 |
| 19 | 2.9 | 2.2 | 2.7 | 2.6 | 2.5 | 3.2 | 2.2 | 2.3 | 2.4 |
| 20 | 2.5 | 2.9 | 2.7 | 2.4 | 2.5 | 2.4 | 2.2 | 2.3 | 2.4 |
| 21 | 2.3 | 3.9 | 2.6 | 2.4 | 2.4 | 2.4 | 2.2 | 2.4 | 2.4 |
| 22 | 2.1 | 3.7 | 5.6 | 3.2 | 2.4 | 2.3 | 2.2 | 2.3 | 2.4 |
| 23 | 2.1 | 3.0 | 3.7 | 2.7 | 2.4 | 2.3 | 2.2 | 2.5 | 2.5 |
| 24 | 4.7 | 2.6 | 3.1 | 4.2 | 2.4 | 2.3 | 2.2 | 4.6 | 2.5 |
| 25 | 5.4 | 4.0 | 2.9 | 3.4 | 2.3 | 2.3 | 2.2 | 3.2 | 2.4 |
| 26 | 3.6 | 3.9 | 2.6 | 2.8 | 2.3 | 2.3 | 2.2 | 2.7 | 2.4 |
| 27 | 2.9 | 11.6 | 2.6 | 2.7 | 2.3 | 2.3 | 2.2 | 2.5 | 2.4 |
| 28 | 2.6 | 4.9 | 2.7 | 2.6 | 2.3 | 2.3 | 2.2 | 2.4 | 2.4 |
| 29 | 2.4 | 3.7 | 2.6 | 3.0 | 2.3 | 2.2 | 2.2 | 2.4 | 2.4 |
| 30 | 2.6 | 3.5 | 2.6 | 2.9 | 2.3 | 2.2 | 2.3 | 2.4 | 2.4 |
| 31 | ........ | 5.1 | ........ | 2.6 | 2.3 | ........ | 2.3 | ........ | ........ |

*Daily discharge, in second feet, of Elm Fork of Red River near Mangum, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 65 | 550 | 50 | 37 | 14 | 9 | 25 | 41 |
| 2 | ........ | 50 | 260 | 50 | 37 | 14 | 9 | 16 | 41 |
| 3 | ........ | 37 | 260 | 50 | 37 | 14 | 9 | 16 | 41 |
| 4 | ........ | 37 | 195 | 50 | 120 | 14 | 9 | 16 | 41 |
| 5 | ........ | 37 | 195 | 50 | 50 | 14 | 16 | 120 | 41 |
| 6 | ........ | 37 | 165 | 37 | 37 | 25 | 16 | 50 | 41 |
| 7 | ........ | 50 | 2,500 | 37 | 65 | 25 | 16 | 65 | 41 |
| 8 | ........ | 50 | 1,150 | 37 | 140 | 25 | 16 | 50 | 41 |
| 9 | ........ | 300 | 400 | 37 | 50 | 120 | 16 | 900 | 41 |
| 10 | ........ | 80 | 195 | 65 | 37 | 225 | 16 | 1,100 | 41 |
| 11 | ........ | 50 | 195 | 65 | 37 | 80 | 16 | 100 | 41 |
| 12 | 16 | 50 | 165 | 50 | 25 | 37 | 16 | 65 | 41 |
| 13 | 16 | 400 | 140 | 37 | 680 | 37 | 9 | 37 | 120 |
| 14 | 10 | 260 | 165 | 37 | 1,400 | 37 | 9 | 25 | 90 |
| 15 | 7 | 80 | 140 | 37 | 165 | 25 | 9 | 25 | 23 |
| 16 | 10 | 37 | 140 | 37 | 80 | 25 | 9 | 25 | 20 |
| 17 | 16 | 26 | 120 | 25 | 65 | 14 | 16 | 25 | 20 |
| 18 | 37 | 16 | 120 | 25 | 50 | 14 | 16 | 16 | 20 |
| 19 | 165 | 37 | 120 | 50 | 37 | 165 | 9 | 16 | 20 |
| 20 | 82 | 165 | 120 | 25 | 37 | 25 | 9 | 16 | 20 |
| 21 | 50 | 680 | 100 | 25 | 25 | 25 | 9 | 25 | 20 |
| 22 | 26 | 550 | 2,150 | 165 | 25 | 14 | 9 | 16 | 20 |
| 23 | 26 | 195 | 550 | 65 | 25 | 14 | 9 | 37 | 23 |
| 24 | 1,350 | 100 | 225 | 900 | 25 | 14 | 9 | 1,250 | 23 |
| 25 | 1,850 | 750 | 165 | 350 | 14 | 14 | 9 | 200 | 20 |
| 26 | 500 | 680 | 100 | 80 | 14 | 14 | 9 | 92 | 20 |
| 27 | 165 | 14,600 | 100 | 65 | 14 | 14 | 9 | 58 | 20 |
| 28 | 100 | 1,500 | 120 | 50 | 14 | 14 | 9 | 48 | 20 |
| 29 | 65 | 550 | 100 | 120 | 14 | 7 | 9 | 44 | 20 |
| 30 | 100 | 400 | 100 | 100 | 14 | 7 | 16 | 44 | 20 |
| 31 | ........ | 1,700 | ........ | 50 | 14 | ........ | 16 | ........ | 20 |

NOTE.—On account of shifting conditions the low-water discharge was computed from several rating tables. The high-water discharge was computed from current-meter and slope measurements.

*Estimated monthly discharge of Elm Fork of Red River near Mangum, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 12-30 | 1,850 | 7 | 242 | 9,120 |
| May | 14,600 | 16 | 760 | 46,730 |
| June | 2,500 | 100 | 367 | 21,840 |
| July | 900 | 25 | 91.0 | 5,595 |
| August | 1,400 | 14 | 109 | 6,702 |
| September | 225 | 7 | 36.2 | 2,154 |
| October | 16 | 9 | 11.7 | 719 |
| November | 1,250 | 16 | 151. | 8,985 |
| December | 120 | 20 | 33.9 | 2,084 |
| The period | ........ | ........ | ........ | 103,900 |

## ELK CREEK NEAR HOBART, OKLA.

This station was established April 13, 1905. It is located at the highway bridge about 7 miles south of Hobart, Okla. The station 3 miles southwest of Hobart, established September 22, 1904, was continued until this station was established. The 1905 gage heights at the old station have been referred to the datum of the new one by adding 0.4 foot.

The channel is straight for 200 feet above and 100 feet below the station. The current is swift and is oblique to the bridge. Both banks are high and wooded. The right bank overflows during extreme high water. The bed of the stream is composed of sand and gravel with very little vegetation and is slightly shifting. There is one channel at all stages up to 20 feet, and two channels at higher stages.

Discharge measurements are made from the downstream side of the bridge. The initial point is at the east end of the bridge, marked with paint.

A standard chain gage is fastened to the bridge; length of chain, 33.45 feet. During 1905 the gage was read once each day by G. W. Hines. Bench marks were established as follows: (1) A standard bench-mark post three-fourths of a mile east of the bridge, 1,459.00 feet above mean sea level and 28.44 feet above the datum of the gage. (2) A paint mark on the downstream end of a bridge beam near the center of the bridge, 1,459.14 feet above mean sea level and 28.58 feet above the datum of the gage.

*Discharge measurements of Elk Creek near Hobart, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 29 | E. R. Kerby | 16 | 14 | 0.71 | 2.00 | 10 |
| February 24 | Whittington and Kerby | 16 | 33 | 1.02 | 2.90 | 34 |
| April 13 | E. R. Kerby | 20 | 9.5 | 2.43 | 2.30 | 23 |
| April 26 | J. M. Giles | 21 | 75 | 2.66 | 5.60 | 200 |
| April 27 | Murphy and Kerby | 19.5 | 30 | 2.22 | 3.76 | 67 |
| May 23 | J. M. Giles | 17 | 21 | 1.81 | 3.00 | 39 |
| May 31 | do | 33 | 148 | 2.69 | 8.57 | 398 |
| May 31 | do | 33 | 151 | 2.68 | 8.65 | 403 |
| July 7 | E. R. Kerby | 17 | 11 | 2.11 | 2.50 | 23 |
| July 12 | do | 16 | 11 | 2.00 | 2.50 | 22 |
| July 26 | J. M. Giles | 14 | 11 | 2.00 | 2.55 | 21 |
| July 26 | do | 16 | 10 | 1.99 | 2.52 | 20 |
| August 3 | E. R. Kerby | 14 | 8 | 1.50 | 2.25 | 12 |
| August 25 | do | 14 | 8 | 1.75 | 2.30 | 13 |
| September 14 | do | 17 | 14 | 1.80 | 2.65 | 25 |
| September 19 | do | 16 | 8 | 1.63 | 2.30 | 13 |
| September 23 | J. M. Giles | 18 | 13 | .85 | 2.25 | 11 |
| September 28 | E. R. Kerby | 15 | 7 | 1.66 | 2.20 | 11 |
| October 14 | do | 11 | 4.2 | 1.48 | 2.10 | 6 |
| October 26 | do | 11 | 4.2 | 1.47 | 2.20 | 6 |
| November 28 | do | | 13 | 1.39 | 2.50 | 18 |
| December 28 | do | | 14 | 1.25 | 2.50 | 17 |

*Daily gage height, in feet, of Elk Creek near Hobart, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 2.3 | 2.2 | 2.2 | 3.1 | 10.9 | 2.7 | 2.2 | 2.2 | 2.2 | 2.2 | 2.3 |
| 2 | 2.3 | 2.3 | 2.2 | 2.2 | 2.5 | 5.3 | 2.7 | 2.3 | 2.2 | 2.2 | 2.2 | 2.3 |
| 3 | 2.3 | 2.3 | 2.2 | 2.4 | 2.3 | 4.2 | 2.7 | 2.3 | 2.3 | 2.2 | 2.2 | 2.3 |
| 4 | 2.3 | 2.3 | 2.2 | 2.4 | 2.3 | 4.3 | 2.6 | 2.2 | 2.2 | 2.2 | 2.7 | 2.3 |
| 5 | 2.3 | 2.3 | 2.3 | 2.4 | 2.2 | 4.1 | 2.6 | 2.2 | 2.2 | 2.2 | 2.4 | 2.3 |
| 6 | 2.3 | 2.3 | 6.4 | 2.4 | 2.1 | 4.2 | 2.5 | 2.2 | 2.2 | 2.2 | 2.4 | 2.3 |
| 7 | 2.3 | 2.3 | 4.4 | 2.3 | 2.1 | 4.1 | 2.5 | 2.3 | 2.2 | 2.2 | 2.8 | 2.3 |
| 8 | 2.3 | 2.3 | 3.1 | 2.2 | 2.2 | 8.5 | 2.6 | 2.3 | 2.6 | 2.2 | 2.5 | 2.3 |
| 9 | 2.3 | 2.3 | 2.8 | 2.2 | 2.2 | 4.6 | 2.7 | 2.3 | 10.1 | 2.2 | 2.5 | 2.4 |
| 10 | 2.3 | 2.3 | 2.6 | 7.9 | 3.2 | 4.2 | 3.9 | 2.2 | 7.0 | 2.2 | 2.4 | 2.4 |
| 11 | 2.5 | 2.3 | 2.4 | 3.4 | 2.2 | 3.9 | 3.2 | 2.2 | 3.9 | 2.2 | 2.3 | 2.4 |
| 12 | 2.5 | 2.3 | 2.3 | 2.8 | 2.4 | 3.4 | 2.9 | 2.2 | 3.0 | 2.1 | 2.3 | 2.4 |
| 13 | 2.5 | 2.3 | 2.3 | 2.3 | 2.2 | 3.5 | 2.8 | 2.2 | 2.8 | 2.1 | 2.3 | 2.5 |
| 14 | 2.5 | 2.3 | 2.3 | 2.3 | 3.0 | 3.4 | 2.7 | 8.2 | 2.7 | 2.1 | 2.3 | 2.5 |
| 15 | 2.5 | 2.3 | 2.2 | 2.2 | 2.5 | 3.4 | 2.5 | 13.5 | 2.6 | 2.1 | 2.3 | 2.5 |
| 16 | 2.5 | 2.3 | 2.5 | 2.1 | 3.0 | 3.3 | 2.4 | 5.4 | 2.5 | 2.1 | 2.3 | 2.6 |
| 17 | 2.5 | 2.4 | 2.9 | 2.0 | 2.1 | 3.3 | 2.4 | 3.4 | 2.5 | 2.2 | 2.3 | 2.6 |
| 18 | 2.5 | 2.4 | 7.1 | 2.2 | 2.1 | 3.1 | 2.3 | 3.3 | 2.5 | 2.2 | 2.3 | 2.6 |
| 19 | 2.5 | 2.4 | 5.9 | 2.2 | 2.0 | 3.1 | 2.3 | 2.9 | 2.3 | 2.2 | 2.3 | 2.5 |
| 20 | 2.5 | 2.4 | 4.4 | 2.1 | 2.0 | 3.0 | 2.3 | 2.8 | 2.3 | 2.2 | 2.3 | 2.5 |
| 21 | 2.5 | 2.4 | 3.5 | 2.0 | 4.2 | 3.0 | 2.2 | 2.6 | 2.3 | 2.1 | 2.3 | 2.5 |
| 22 | 2.5 | 2.4 | 3.0 | 2.0 | 3.9 | 3.0 | 4.3 | 2.5 | 2.3 | 2.1 | 2.3 | 2.5 |
| 23 | 2.4 | 4.4 | 2.6 | 2.1 | 2.6 | 2.9 | 4.0 | 2.4 | 2.2 | 2.1 | 3.4 | 2.5 |
| 24 | 2.4 | 3.4 | 2.4 | 6.2 | 2.3 | 2.9 | 3.4 | 2.4 | 2.2 | 2.2 | 3.4 | 2.5 |
| 25 | 2.4 | 3.0 | 2.3 | 13.2 | 2.3 | 2.8 | 2.9 | 2.3 | 2.2 | 2.2 | 3.3 | 2.5 |
| 26 | 2.4 | 2.4 | 2.3 | 8.1 | 7.0 | 2.8 | 2.5 | 2.3 | 2.2 | 2.2 | 3.3 | 2.5 |
| 27 | 2.4 | 2.4 | 2.3 | 3.6 | 16.5 | 2.8 | 2.4 | 2.3 | 2.2 | 2.2 | 2.5 | 2.5 |
| 28 | 2.4 | 2.2 | 2.2 | 3.0 | 24.2 | 2.7 | 2.3 | 2.2 | 2.2 | 2.3 | 2.5 | 2.6 |
| 29 | 2.4 | ....... | 2.2 | 2.7 | 21.9 | 2.7 | 2.2 | 2.2 | 2.2 | 2.3 | 2.4 | 2.6 |
| 30 | 2.3 | ....... | 2.1 | 3.3 | 6.4 | 2.7 | 2.2 | 2.2 | 2.2 | 2.3 | 2.4 | 2.6 |
| 31 | 2.3 | ....... | 2.2 | ....... | 9.2 | ....... | 2.2 | 2.2 | ....... | 2.3 | ....... | 2.6 |

## OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 2, 1903, by G. H. Matthes. It is located on G. M. Dale's homestead, in the SE. ¼ sec. 21, T. 3 N., R. 17 W. of the Indian meridian. It is 2 miles west and 1 mile north of Mountain Park, Okla.

The channel is slightly curved both above and below the station. Both banks are about 20 feet high, of sandy loam, covered with vegetation, and subject to overflow. The bed of the stream is of sand and is liable to shift. The water flows in one channel at normal stages, but when about to overflow its banks part of the water is diverted through a slough into Horse Creek.

Discharge measurements are made by wading at low stage and from a cable about 100 yards below the gage at ordinary and flood stages.

The gage is a staff fastened to a cottonwood tree which stands at the water's edge. During 1905 the gage was read once each day by G. M. Dale. Bench marks were established as follows: (1) A 20-penny nail driven into the cottonwood tree to which the gage is attached; elevation, 10.00 feet. (2) A nail driven into a mesquite tree 150 feet southwest of G. M. Dale's house; elevation, 28.62 feet. (3) A nail driven into a hackberry tree 50 feet east of the creek and 20 feet north of the gage; elevation, 8.94 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 316–317; 131, p 185.
Discharge: 99, p 317; 131, p 185.
Discharge, monthly: 99, p 319; 131, p 187.
Gage heights: 99, 317-318; 131, p 186.
Rating table: 99, p, 318

*Discharge measurements of Otter Creek near Mountain Park, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.*[a] |
| January 30 | E. R. Kerby | 5 | 0.75 | 1.00 | 1.00 | 0.75 |
| February 25 | do | 7 | 2.5 | .80 | 1.20 | 2.0 |
| April 19 | do | 9 | 4 | 1.35 | 1.20 | 5.4 |
| May 13 | do | 61 | 746 | 2.37 | 13.30 | 1,772 |
| May 14 | do | 29 | 71 | 1.86 | 3.30 | 133 |
| May 17 | do | 19 | 18 | 1.38 | 1.70 | 25 |
| May 20 | Kerby and Osburne | 54 | 448 | 2.97 | 11.00 | 1,332 |
| May 22 | J. M. Giles | 53 | 364 | 1.53 | 6.50 | 556 |
| May 24 | E. R. Kerby | 18 | 22 | 1.84 | 2.00 | 39 |
| May 31 | do | 52 | 409 | 1.79 | 7.40 | 732 |
| June 1 | J. M. Giles | 33 | 95 | 1.36 | 2.95 | 129 |
| June 28 | E. R. Kerby | 19 | 7 | 1.20 | 1.20 | 8 |
| July 6 | do | 15 | 5 | .86 | 1.20 | 4.3 |
| July 6 | do | 6 | 3.7 | 1.16 | 1.20 | 4.3 |
| July 8 | do | 13 | 4.5 | 1.20 | 1.25 | 5.4 |
| July 13 | do | 12 | 5.4 | .91 | 1.20 | 5.0 |
| July 15 | do | 12 | 5.4 | 1.00 | 1.25 | 5.4 |
| July 15 | J. M. Giles | 12 | 4.0 | .86 | 1.20 | 3.4 |
| July 19 | E. R. Kerby | 12 | 4.0 | .75 | 1.15 | 3.0 |
| July 20 | do | 12 | 5 | .76 | 1.20 | 3.8 |
| July 21 | J. M. Giles | 5 | 2.9 | .82 | 1.15 | 2.4 |
| July 22 | do | 23 | 14 | 1.35 | 1.62 | 19 |
| July 24 | E. R. Kerby | 18 | 13.5 | 1.41 | 1.50 | 19 |
| July 26 | do | 12 | 5.1 | 1.08 | 1.20 | 5.6 |
| July 27 | do | 12 | 5.2 | 1.12 | 1.20 | 5.8 |
| August 3 | do | 10 | 2.9 | 1.08 | 1.15 | 3.1 |
| August 8 | do | 7 | 3.9 | .67 | 1.10 | 2.6 |
| August 10 | do | 7 | 4.4 | .70 | 1.10 | 3.1 |
| August 20 | do | 5.5 | 1.7 | 1.05 | 1.10 | 1.8 |
| August 27 | do | 5 | 1.4 | .94 | 1.00 | 1.3 |
| August 29 | do | 5 | 2.1 | .28 | 1.0 | .6 |
| September 4 | do | 3 | .6 | 1.00 | .95 | .6 |
| September 12 | do | 5.5 | 1.5 | .90 | 1.20 | 1.4 |
| September 15 | do | 5.5 | 1.5 | .87 | 1.15 | 1.3 |
| September 18 | do | 3 | .6 | 1.00 | 1.10 | [a].6 |
| September 21 | J. M. Giles | 1.6 | .3 | .65 | 1.00 | .2 |
| September 29 | E R Kerby | 3 | .6 | 1.00 | 1.00 | [a].6 |
| October 3 | do | 3 | 6 | 1.00 | 1.00 | [a].6 |
| October 5 | do | 3 | .6 | 1 00 | 1.00 | [a].6 |
| October 12 | do | 3 | .6 | 1.00 | 1.00 | .6 |
| October 15 | do | 3 | .6 | 1.00 | 1.00 | [a].6 |
| October 21 | do | 3 | .6 | 1.00 | 1.00 | [a].6 |
| November 11 | do | 27 | 16 | .81 | 1.60 | 13 |
| November 12 | do | 27 | 15 | .80 | 1.50 | 12 |
| November 24 | do | 10 | 6 | 1.00 | 1.40 | 6 |

[a] Float measurement.

*Daily gage height, in feet, of Otter Creek near Mountain Park, Okla, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9 | 1.1 | 1.1 | 5.2 | 1.6 | 3.0 | 1.4 | 1.1 | 1.0 | 1.0 | 1.1 | 1.2 |
| 2 | .9 | 1.1 | 1.1 | 3.8 | 1.5 | 2.4 | 1.3 | 1.1 | 1.0 | 1.1 | 1.1 | 1.2 |
| 3 | .9 | 1.1 | 1.1 | 2.0 | 1.5 | 2.0 | 1.2 | 1.2 | 1.0 | 1.1 | 1.1 | 1.2 |
| 4 | .9 | 1.1 | 1.1 | 1.6 | 1.5 | 1.8 | 1.2 | 1.3 | 1.0 | 1.1 | 1.2 | 1.1 |
| 5 | .9 | 1.1 | 1.1 | 1.5 | 1.4 | 1.7 | 1.2 | 1.2 | 1.0 | 1.1 | 1.9 | 1.1 |
| 6 | .9 | 1.1 | 1.1 | 1.7 | 1.4 | 1.5 | 1.2 | 1.2 | 1.1 | 1.1 | 1.5 | 1.1 |
| 7 | .9 | 1.1 | 1.3 | 1.5 | 1.4 | 1.5 | 1.2 | 1.2 | 1.1 | 1.1 | 1.3 | 1.1 |
| 8 | .9 | 1.1 | 1.3 | 1.3 | 1.4 | 1.5 | 1.2 | 1.2 | 1.1 | 1.1 | 1.3 | 1.1 |
| 9 | 1.0 | 1.1 | 1.3 | 1.3 | 1.45 | 1.5 | 2.0 | 1.1 | 1.3 | 1.1 | 2.5 | 1.1 |
| 10 | 1.0 | 1.2 | 1.2 | 1.2 | 1.5 | 1.5 | 1.5 | 1.1 | 1.2 | 1.1 | 2.5 | 1.1 |
| 11 | 1.0 | 1.2 | 1.2 | 1.1 | 5.0 | 1.5 | 1.3 | 1.1 | 1.2 | 1.1 | 1.8 | 1.1 |
| 12 | 1.0 | 1.2 | 1.2 | 1.1 | 12.0 | 1.5 | 1.3 | 1.1 | 1.2 | 1.1 | 1.4 | 1.1 |
| 13 | 1.0 | 1.1 | 1.1 | 1.1 | 13.1 | 1.5 | 1.3 | 2.9 | 1.2 | 1.0 | 1.3 | 1.4 |
| 14 | 1.0 | 1.1 | 1.1 | 1.0 | 4.1 | 1.4 | 1.2 | 1.8 | 1.2 | 1.0 | 1.3 | 1.3 |
| 15 | 1.0 | 1.1 | 1.8 | 1.0 | 2.4 | 1.4 | 1.2 | 1.5 | 1.2 | 1.0 | 1.2 | 1.3 |
| 16 | 1.0 | 1.1 | 2.15 | 1.0 | 1.9 | 1.4 | 1.2 | 1.3 | 1.2 | 1.0 | 1.2 | 1.3 |
| 17 | 1.1 | 1.2 | 2.45 | 1.0 | 1.7 | 1.4 | 1.2 | 1.2 | 1.1 | 1.0 | 1.2 | 1.3 |
| 18 | 1.2 | 1.3 | 2.6 | 1.2 | 1.6 | 1.4 | 1.2 | 1.2 | 1.1 | 1.0 | 1.2 | 1.2 |
| 19 | 1.1 | 1.3 | 1.7 | 1.2 | 1.6 | 1.3 | 1.2 | 1.1 | 1.1 | 1.0 | 1.1 | 1.2 |
| 20 | 1.1 | 1.3 | 1.4 | 1.2 | 8.4 | 1.3 | 1.2 | 1.1 | 1.1 | 1.0 | 1.2 | 1.2 |
| 21 | 1.1 | 1.2 | 1.2 | 1.1 | 4.8 | 1.3 | 1.1 | 1.1 | 1.1 | 1.0 | 1.2 | 1.2 |
| 22 | 1.1 | 1.2 | 1.2 | 1.1 | 5.9 | 1.3 | 2.4 | 1.1 | 1.0 | 1.0 | 1.2 | 1.2 |
| 23 | 1.0 | 1.2 | 1.1 | 2.7 | 3.0 | 1.3 | 1.5 | 1.1 | 1.0 | 1.0 | 1.2 | 1.2 |
| 24 | 1.0 | 1.3 | 1.1 | 7.8 | 2.3 | 1.3 | 1.5 | 1.1 | 1.0 | 1.1 | 1.3 | 1.2 |
| 25 | 1.0 | 1.2 | 1.1 | 14.0 | 2.3 | 1.3 | 1.3 | 1.0 | 1.0 | 1.1 | 1.3 | 1.2 |
| 26 | 1.0 | 1.2 | 1.1 | 5.0 | 2.6 | 1.3 | 1.3 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 |
| 27 | 1.0 | 1.1 | 1.1 | 2.8 | 19.3 | 1.3 | 1.2 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 |
| 28 | 1.0 | 1.1 | 1.1 | 2.1 | 6.0 | 1.2 | 1.2 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 |
| 29 | 1.0 | ....... | 1.2 | 1.8 | 3.2 | 1.2 | 1.1 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 |
| 30 | 1.0 | ....... | 1.1 | 1.7 | 8.3 | 1.2 | 1.1 | 1.0 | 1.0 | 1.1 | 1.2 | 1.2 |
| 31 | 1.1 | ....... | 1.1 | ....... | 6.5 | ....... | 1.1 | 1.0 | ....... | 1.1 | ....... | 1.2 |

*Daily discharge in second-feet, of Otter Creek near Mountain Park, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 384 | 24 | 120 | 14 | 3 | 0.6 | 0.6 | 1 | 2 |
| 2 | 208 | 20 | 64 | 10 | 3 | .6 | 1 | 1 | 2 |
| 3 | 37 | 19 | 37 | 5 | 4 | .6 | 1 | 1 | 2 |
| 4 | 28 | 19 | 37 | 5 | 6 | .6 | 1 | 3 | 1 |
| 5 | 23 | 13 | 32 | 4 | 4 | .6 | 1 | 30 | 1 |
| 6 | 33 | 13 | 21 | 5 | 4 | 1 | 1 | 10 | 1 |
| 7 | 23 | 13 | 21 | 6 | 4 | 1 | 1 | 4 | 1 |
| 8 | 13 | 13 | 21 | 4 | 4 | 1 | 1 | 4 | 1 |
| 9 | 13 | 15 | 21 | 37 | 3 | 3 | 1 | 72 | 1 |
| 10 | 9 | 17 | 21 | 15 | 3 | 2 | 1 | 72 | 1 |
| 11 | 6 | 357 | 21 | 7 | 3 | 2 | 1 | 24 | 1 |
| 12 | 6 | 1,525 | 21 | 7 | 3 | 1 | 1 | 8 | 1 |
| 13 | 6 | 1,730 | 21 | 8 | 110 | 1 | .6 | 5 | 6 |
| 14 | 3 | 243 | 16 | 5 | 28 | 2 | .6 | 5 | 4 |
| 15 | 4 | 64 | 16 | 4 | 13 | 2 | .6 | 3 | 4 |
| 16 | 3 | 36 | 16 | 3 | 6 | 2 | .6 | 3 | 4 |
| 17 | 4 | 25 | 16 | 4 | 3 | .6 | .6 | 3 | 4 |
| 18 | 9 | 20 | 16 | 3 | 3 | .6 | .6 | 3 | 2 |
| 19 | 9 | 20 | 12 | 4 | 2 | .6 | .6 | 1 | 2 |
| 20 | 9 | 880 | 12 | 4 | 2 | .6 | .6 | 3 | 2 |
| 21 | 6 | 330 | 12 | 2 | 2 | .6 | .6 | 2 | 2 |
| 22 | 6 | 480 | 12 | 64 | 2 | .3 | .6 | 2 | 2 |
| 23 | 90 | 120 | 12 | 16 | 2 | .4 | .6 | 2 | 2 |
| 24 | 775 | 56 | 12 | 19 | 2 | .5 | 1 | 4 | 2 |
| 25 | 1,900 | 56 | 12 | 9 | 1 | .5 | 1 | 4 | 2 |
| 26 | 357 | 80 | 12 | 9 | 1 | .5 | 1 | 2 | 2 |
| 27 | 100 | 2,910 | 12 | 7 | 1 | .6 | 1 | 2 | 2 |
| 28 | 43 | 495 | 8 | 6 | .8 | .6 | 1 | 2 | 2 |
| 29 | 36 | 141 | 8 | 4 | .6 | .6 | 1 | 2 | 2 |
| 30 | 30 | 860 | 7 | 3 | .6 | .6 | 1 | 2 | 2 |
| 31 | ........ | 570 | ........ | 3 | .6 | ........ | 1 | ........ | 2 |

NOTE.—The daily discharge was obtained by indirect method. As no measurements were made prior to April 1 no estimates were made for that period.

*Estimated monthly discharge of Otter Creek near Mountain Park, Okla., for 1905.*

[Drainage area, 126 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 1,900 | 3 | 139 | 8,271 | 1.10 | 1.23 |
| May | 2,910 | 13 | 360 | 22,140 | 2.86 | 3.30 |
| June | 120 | 7 | 22.3 | 1,327 | .177 | .198 |
| July | 64 | 2 | 9.5 | 584 | .075 | .086 |
| August | 110 | .6 | 7.2 | 443 | .057 | .066 |
| September | 3 | .3 | .95 | 57 | .0075 | .0084 |
| October | 1 | .6 | .85 | 52 | .0067 | .0077 |
| November | 72 | 1 | 9.3 | 553 | .074 | .083 |
| December | 6 | 1 | 2.1 | 129 | .017 | .020 |
| The period | .......... | .......... | .......... | 33,560 | .......... | .......... |

## HORSE CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 17, 1905. It is located 5 miles north of Mountain Park, in the SE. ¼ sec. 1, T. 3 N., R. 17 W., of the Indian meridian.

The channel is straight for 50 feet above and 200 feet below the station. The current is sluggish. Both banks are low, covered with grass and weeds, and subject to overflow during high water. The bed of the stream is composed of firm earth, covered with vegetation, and is fairly permanent. There is but one channel.

Discharge measurements are made by wading near the gage. At high water measurements are made by means of a boat.

The gage is a staff with an auxiliary gage 600 feet downstream from the regular gage, for determining the slope of the stream. During 1905 the gage was read once each day by John S. Cundiff, when the stream was flowing. The bench mark is a nail driven into the elm tree to which the gage is fastened; elevation, 5.65 feet above the datum of the gage.

*Discharge measurements of Horse Creek near Mountain Park, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 28 | Murphy and Giles | 3.3 | 1.33 | 0.54 | 0.71 | 0.72 |
| May 14 | E. R. Kerby | 5 | 5.8 | 1.16 | 1.60 | 6.7 |
| May 20 | J. M. Giles | 16 | 30 | .86 | 2.95 | 26.3 |
| July 6 | E. R. Kerby | | | | .40 | 0 |
| November 24 | do | | .8 | .67 | .60 | .54 |
| (a) | J. M. Giles | | 90 | 2.30 | 5.00 | 207 |

[a] Computed from slope measurement using Kutter's formula.

*Daily gage height, in feet, of Horse Creek near Mountain Park, Okla. for 1905.*

| Day. | Apr. | May. | June. | July. | Dec. | Day. | Apr. | May. | June. | July. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.5 | 1.3 | 0.7 | | 17 | | 0.7 | | | 0.4 |
| 2 | | .5 | 1.0 | | | 18 | 0.9 | .7 | | | .4 |
| 3 | | .5 | .8 | | | 19 | 1.0 | .6 | | | .4 |
| 4 | | .4 | .7 | | | 20 | .8 | 5.4 | | | .4 |
| 5 | | .4 | .7 | | | 21 | .5 | 3.2 | | | .4 |
| 6 | | .4 | .7 | | | 22 | .5 | 3.0 | | | .4 |
| 7 | | .4 | .7 | | | 23 | 6.0 | 1.3 | | | .4 |
| 8 | | | .7 | | | 24 | 2.4 | .9 | | | .4 |
| 9 | | | .6 | 1.5 | | 25 | 3.0 | 1.7 | | | .4 |
| 10 | | .6 | .6 | | | 26 | 1.3 | 1.2 | | | .4 |
| 11 | | 2.9 | .7 | | | 27 | .8 | 7.0 | | | .4 |
| 12 | | 5.5 | .7 | | | 28 | .7 | 2.1 | | | .4 |
| 13 | | 6.0 | .5 | | | 29 | .6 | 1.2 | | | .4 |
| 14 | | 1.6 | | | | 30 | .5 | 4.8 | | | .4 |
| 15 | | 1.0 | | | | 31 | | 2.7 | | | |
| 16 | | .8 | | | | | | | | | |

## DRY FORK OF OTTER CREEK NEAR MOUNTAIN PARK, OKLA.

This station was established April 18, 1905. It is located about 4 miles northeast of Mountain Park, Okla., in sec. 15, T. 3 N., R. 16 W., of the Indian meridian.

The channel is straight for 200 feet above and below the station. The current is swift. The left bank is high; the right is low. Both are wooded and subject to overflow. The bed is sand and gravel, free from vegetation and slightly shifting. There is but one channel.

Discharge measurements are made by wading near the gage.

The gage is a staff with an auxiliary gage 500 feet upstream from the regular gage for determining the slope. During 1905 the gage was read once each day by A. B. Slaybaugh. The bench mark is a nail driven into a leaning cottonwood tree near a pump 35 feet upstream from the gage; elevation, 6.53 feet above the datum of the gage.

*Discharge measurements of Dry Fork of Otter Creek near Mountain Park, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | E. R. Kerby | 8 | 3 | 1.35 | 0.80 | 4 |
| April 28 | Murphy and Giles | 9 | 5 | 1.65 | .90 | 8 |
| May 14 | E. R. Kerby | 14 | 14 | 2.04 | 1.50 | 28 |
| May 20 | J. M. Giles | 28 | 22 | 1.06 | 1.40 | 23 |
| June 12 | E. R. Kerby | 9 | 4 | 1.17 | .70 | 4 |
| July 13 | do | 4 | 1.2 | .83 | .40 | 1 |
| July 15 | J. M. Giles | 6 | 2.2 | .28 | .45 | .6 |
| August 8 | E. R. Kerby | 1 | .5 | 1.00 | .40 | .5 |
| November 24 | do | | 2.6 | .96 | .80 | 2.5 |
| December 15 | do | | 1.8 | 1.33 | .60 | 2.4 |
| December 29 | do | | 1.5 | 1.20 | .50 | 1.8 |
| (a) | J. M. Giles | | 104 | 3.43 | 4.00 | 357 |
| (a) | do | | 139 | 3.88 | 5.00 | 539 |
| (a) | do | 75 | 268 | 5.05 | 8.00 | 1,353 |

[a] Computed from slope measurements, using Kutter's formula.

*Daily gage height, in feet, of Dry Fork of Otter Creek near Mountain Park, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 0.7 | 1.1 | 0.7 | 0.4 | ........ | ........ | 0.4 | 0.4 |
| 2 | ........ | .7 | 1.0 | .6 | .4 | ........ | ........ | .4 | .4 |
| 3 | ........ | .7 | 1.0 | .5 | .8 | ........ | 0.3 | .4 | .4 |
| 4 | ........ | .6 | .8 | .5 | .5 | ........ | .3 | .5 | .4 |
| 5 | ........ | .6 | .8 | .5 | .4 | ........ | .3 | .5 | .4 |
| 6 | ........ | .6 | .7 | .5 | .4 | ........ | .3 | .6 | .4 |
| 7 | ........ | .5 | .7 | .5 | .4 | ........ | .3 | .6 | .4 |
| 8 | ........ | .5 | .7 | .5 | .4 | 0.8 | .3 | .6 | .4 |
| 9 | ........ | .5 | .7 | .7 | .4 | .5 | .3 | .7 | .4 |
| 10 | ........ | 2.8 | .7 | .6 | .4 | .5 | .3 | .6 | .4 |
| 11 | ........ | 2.2 | .8 | .5 | .4 | .5 | ........ | .6 | .4 |
| 12 | ........ | 5.5 | .7 | .5 | .4 | .4 | ........ | .5 | .4 |
| 13 | ........ | 8.4 | .7 | .4 | .9 | .4 | ........ | .5 | .7 |
| 14 | ........ | 1.7 | .7 | .4 | .7 | .3 | ........ | .5 | .6 |
| 15 | ........ | 1.4 | .6 | .5 | .5 | .3 | ........ | .4 | .6 |
| 16 | ........ | 1.0 | .6 | .5 | .4 | .3 | ........ | .4 | .5 |
| 17 | ........ | .9 | .6 | .4 | .4 | .3 | ........ | .4 | .5 |
| 18 | ........ | .9 | .6 | .4 | .4 | .3 | ........ | .4 | .5 |
| 19 | 0.7 | .8 | .6 | .4 | .4 | .3 | ........ | .4 | .4 |
| 20 | .6 | 2.5 | .6 | .4 | .4 | .3 | ........ | .4 | .4 |
| 21 | .6 | 2.3 | .6 | .5 | .4 | .3 | ........ | .4 | .4 |
| 22 | .5 | 1.9 | .6 | .5 | .3 | .3 | ........ | .4 | .5 |
| 23 | 2.0 | 1.2 | .6 | .7 | ........ | .3 | .3 | .5 | .4 |
| 24 | 1.4 | 1.1 | .5 | .5 | ........ | .3 | .4 | .8 | .4 |
| 25 | 2.8 | 1.2 | .5 | .5 | ........ | .3 | .4 | .6 | .4 |
| 26 | 1.4 | 3.0 | .5 | .5 | ........ | .3 | .4 | .5 | .4 |
| 27 | 1.1 | 5.1 | .5 | .4 | ........ | .3 | .3 | .5 | .4 |
| 28 | .9 | 1.3 | .5 | .4 | ........ | .3 | .3 | .5 | .4 |
| 29 | .8 | 1.2 | .5 | .4 | ........ | ........ | .3 | .5 | .3 |
| 30 | .7 | 1.4 | .5 | .4 | ........ | ........ | .3 | .5 | .4 |
| 31 | ........ | 1.3 | ........ | .4 | ........ | ........ | .4 | ........ | .4 |

**Note.**—Creek dry August 23 to September 7, September 29 to October 2, and October 11-22, inclusive.

*Station rating table for Dry Fork of Otter Creek near Mountain Park, Okla., from April 19 to October 10, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 0.2 | 1.50 | 29 | 2.70 | 157 | 3.90 | 343 |
| .40 | .4 | 1.60 | 36 | 2.80 | 171 | 4.00 | 360 |
| .50 | 1.0 | 1.70 | 44 | 2.90 | 185 | 4.20 | 394 |
| .60 | 2.0 | 1.80 | 53 | 3.00 | 200 | 4.40 | 429 |
| .70 | 3.5 | 1.90 | 63 | 3.10 | 215 | 4.60 | 465 |
| .80 | 5.4 | 2.00 | 73 | 3.20 | 230 | 4.80 | 501 |
| .90 | 7.8 | 2.10 | 84 | 3.30 | 245 | 5.00 | 539 |
| 1.00 | 10 | 2.20 | 95 | 3.40 | 261 | 5.20 | 577 |
| 1.10 | 13 | 2.30 | 106 | 3.50 | 277 | 5.40 | 616 |
| 1.20 | 16 | 2.40 | 118 | 3.60 | 293 | | |
| 1.30 | 20 | 2.50 | 130 | 3.70 | 309 | | |
| 1.40 | 24 | 2.60 | 143 | 3.80 | 326 | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during the first part of 1905. It is well defined between gage heights 0.4 foot and 1.5 feet. Above 1.5 feet the rating curve is based on computations from three slope measurements, using Kutter's formula. This extension should be considered only roughly approximate. Owing to shifting conditions a second table applies subsequent to October 10.

*Station rating table for Dry Fork of Otter Creek near Mountain Park, Okla., from October 11 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 0.1 | 0.50 | 0.6 | 0.70 | 1.6 |
| .40 | .3 | .60 | 1.0 | .80 | 2.4 |

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. It is well defined.

*Estimated monthly discharge of Dry Fork of Otter Creek near Mountain Park, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 19-30 | 171 | 1.0 | 27.5 | 654 |
| May | 1,500 | 1.0 | 119 | 7,317 |
| June | 13 | 1.0 | 3.4 | 202 |
| July | 3.5 | .4 | 1.1 | 68 |
| August | 7.8 | .0 | .82 | 50 |
| September | 5.4 | .0 | .41 | 24 |
| October | .3 | .0 | .11 | 6.8 |
| November | 2.4 | .3 | .66 | 40 |
| December | 1.6 | .1 | .42 | 26 |
| The period | | | | 8,388 |

### SALT FORK OF RED RIVER AT MANGUM, OKLA.

This station was established April 11, 1905. It is located at the highway bridge one-half mile south of Mangum, Okla.

The channel is straight for 1,000 feet above and 2,000 feet below the station. The current is swift. Both banks are low, clean, and sandy, but do not overflow except under the bridge. The bed of the stream is composed of sand and is shifting. There is but one channel broken only by the pile supports of the bridge.

Discharge measurements are made by wading during low water, and from the bridge during high water. The bridge consists of ten 40-foot steel spans on piles, which catch drift during flood stages. The initial point for soundings is the north end of the bridge.

A standard chain gage is fastened to the downstream railing of the bridge; length of chain, 19.54 feet. During 1905 the gage was read once each day by C. O. Bowles. Bench marks were established as follows: (1) An iron post driven flush with the surface on the west side of the road near a mesquite shrub just south of the cut for the highway and about 200 feet from the left bank of the stream; elevation, 12.46 feet. (2) A paint mark on the crossbeam plate on the same side of the bridge as the gage; elevation, 14.30 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Salt Fork of Red River at Mangum, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 11 | E. R. Kerby | 43 | 20 | .70 | 2.80 | 14 |
| April 26 | Murphy and Kerby | 112 | 323 | 2.30 | 3.43 | 741 |
| May 23 | E. R. Kerby | 138 | 133 | 1.67 | 3.00 | 222 |
| May 25 | J. M. Giles | 202 | 174 | 1.62 | 3.18 | 281 |
| May 25 | do | 206 | 288 | 2.33 | 3.40 | 672 |
| May 26 | do | 110 | 79 | 1.32 | 2.90 | 104 |
| May 27 | do | 415 | 2,218 | 6.33 | 9.00 | 14,040 |
| June 10 | E. R. Kerby | 83 | 78 | 1.71 | 1.90 | 134 |
| July 11 | do | 148 | 88 | 1.58 | 2.10 | 139 |
| July 25 | J. M. Giles | 126 | 114 | 2.10 | 2.33 | 239 |
| August 24 | E. R. Kerby | | | | 1.50 | [a]1 |
| September 24 | J. M. Giles | 8 | 3 | .60 | 1.30 | 2 |
| September 27 | E. R. Kerby | 4 | .5 | 1.00 | 1.30 | .5 |
| November 29 | do | | 62 | 1.29 | 2.20 | 80 |
| December 5 | do | | 63 | 1.29 | 2.20 | 81 |
| December 19 | do | | 56 | 1.16 | 2.50 | 66 |
| (b) | J. M. Giles | | 1,276 | 6.78 | 7.50 | 8,590 |
| (b) | do | | 833 | 5.05 | 6.00 | 4,210 |

(a) Estimated.
(b) Computed from slope measurement using Kutter's formula.

*Daily gage height, in feet, of Salt Fork of Red River at Mangum, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 |  | 2.5 | 2.4 |  | 2.0 |  |  | 2.2 |
| 2 |  |  | 2.4 |  | 2.0 |  |  | 2.2 |
| 3 |  |  |  |  | 2.35 |  |  | 2.2 |
| 4 |  |  |  |  | 2.1 |  | 1.8 | 2.2 |
| 5 |  |  |  |  | 2.0 |  | 1.9 | 2.2 |
| 6 |  |  |  |  | 2.5 | 2.3 | 1.8 | 2.2 |
| 7 |  |  | 3.2 |  | 1.9 | 2.0 | 1.7 | 2.2 |
| 8 |  |  | 2.3 |  | 3.0 | 2.0 | 1.7 | 2.2 |
| 9 |  |  | 2.2 | 2.5 | 2.0 | 1.9 | 1.7 | 2.2 |
| 10 |  |  | 2.2 | 2.2 | 1.9 | 1.7 | 3.0 | 2.2 |
| 11 | 2.8 |  | 2.6 | 2.0 | 1.8 | 1.7 | 2.6 | 2.2 |
| 12 | 2.6 |  | 2.2 | 1.8 | 1.7 | 1.7 | 2.5 | 2.2 |
| 13 | 2.5 |  | 2.2 |  | 3.8 | 1.7 | 2.4 | 2.6 |
| 14 | 2.4 |  | 2.0 |  | 2.7 | 1.6 | 2.4 | 2.6 |
| 15 |  |  | 2.0 |  | 2.3 | 1.6 | 2.4 | 2.5 |
| 16 |  |  | 2.0 |  | 2.1 | 1.5 | 2.3 | 2.5 |
| 17 |  |  | 1.9 |  | 2.0 |  | 2.2 | 2.5 |
| 18 | 3.5 |  | 1.9 |  | 1.8 |  | 2.2 | 2.4 |
| 19 | 3.55 |  | 1.8 |  | 1.6 |  | 2.2 | 2.3 |
| 20 |  | 3.2 | 1.7 |  |  |  | 2.2 | 2.2 |
| 21 |  | 3.3 | 1.6 |  |  |  | 2.1 | 2.2 |
| 22 |  | 3.3 | 2.4 |  |  |  | 2.1 | 2.5 |
| 23 |  | 2.9 | 2.1 | 2.5 |  |  | 2.4 | 2.7 |
| 24 | 6.2 |  | 2.0 | 2.9 |  |  | 3.9 | 2.9 |
| 25 | 3.3 | 3.2 |  | 2.5 |  |  | 3.0 | 2.7 |
| 26 | 3.1 | 2.9 |  | 2.2 |  |  | 2.4 | 2.5 |
| 27 | 2.8 | 7.5 |  | 2.5 |  |  | 2.4 | 2.5 |
| 28 | 2.8 |  |  | 2.2 |  |  | 2.3 | 2.5 |
| 29 | 2.6 | 3.0 |  | 2.2 |  |  | 2.2 | 2.5 |
| 30 | 2.5 | 2.9 |  | 2.1 |  |  | 2.2 | 2.5 |
| 31 |  | 2.7 |  | 2.0 |  |  |  | 2.5 |

**Note.**—No flow for missing gage heights; water standing in pools.

*Daily discharge, in second-feet, of Salt Fork of Red River at Mangum, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 5 | 360 | 0 | 115 | 0 | 0 | 0 | 82 |
| 2 | ........ | 0 | 360 | 0 | 115 | 0 | 0 | 0 | 84 |
| 3 | ........ | 0 | 0 | 0 | 255 | 0 | 0 | 0 | 85 |
| 4 | ........ | 0 | 0 | 0 | 150 | 0 | 0 | 5 | 85 |
| 5 | ........ | 0 | 0 | 0 | 115 | 0 | 0 | 10 | 85 |
| 6 | ........ | 0 | 0 | 0 | 325 | 180 | 0 | 5 | 85 |
| 7 | ........ | 0 | 725 | 0 | 80 | 110 | 0 | 2 | 85 |
| 8 | ........ | 0 | 315 | 0 | 620 | 110 | 0 | 2 | 85 |
| 9 | ........ | 0 | 270 | 325 | 120 | 75 | 0 | 2 | 85 |
| 10 | ........ | 0 | 270 | 185 | 80 | 30 | 0 | 475 | 85 |
| 11 | 18 | 0 | 420 | 115 | 50 | 30 | 0 | 240 | 85 |
| 12 | 10 | 0 | 270 | 50 | 30 | 30 | 0 | 200 | 85 |
| 13 | 5 | 0 | 270 | 0 | 1,240 | 30 | 0 | 160 | 120 |
| 14 | 2 | 0 | 175 | 0 | 440 | 10 | 0 | 160 | 110 |
| 15 | 0 | 0 | 175 | 0 | 230 | 10 | 0 | 160 | 80 |
| 16 | 0 | 0 | 175 | 0 | 150 | 1 | 0 | 120 | 75 |
| 17 | 0 | 0 | 135 | 0 | 115 | 0 | 0 | 85 | 70 |
| 18 | 825 | 0 | 135 | 0 | 50 | 0 | 0 | 85 | 40 |
| 19 | 880 | 0 | 100 | 0 | 10 | 0 | 0 | 85 | 30 |
| 20 | 0 | 450 | 70 | 0 | 0 | 0 | 0 | 85 | 20 |
| 21 | 0 | 620 | 50 | 0 | 0 | 0 | 0 | 60 | 20 |
| 22 | 0 | 620 | 270 | 0 | 0 | 0 | 0 | 60 | 70 |
| 23 | 0 | 110 | 220 | 325 | 0 | 0 | 0 | 150 | 160 |
| 24 | 4,900 | 100 | 175 | 555 | 0 | 0 | 0 | 1,250 | 260 |
| 25 | 620 | 450 | 0 | 325 | 0 | 0 | 0 | 475 | 160 |
| 26 | 330 | 110 | 0 | 185 | 0 | 0 | 0 | 160 | 70 |
| 27 | 20 | 8,600 | 0 | 325 | 0 | 0 | 0 | 150 | 70 |
| 28 | 20 | 600 | 0 | 185 | 0 | 0 | 0 | 110 | 70 |
| 29 | 10 | 725 | 0 | 185 | 0 | 0 | 0 | 80 | 70 |
| 30 | 5 | 670 | 0 | 150 | 0 | 0 | 0 | 80 | 70 |
| 31 | ........ | 540 | ........ | 115 | 0 | ........ | 0 | ........ | 70 |

NOTE.—On account of shifting conditions the low-water discharge was computed from several rating tables, each covering a short period. The high-water discharge was computed from one current-meter and two slope measurements.

*Estimated monthly discharge of Salt Fork of Red River at Mangum, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 11-30 | 4,900 | 0 | 382 | 15,150 |
| May | 8,600 | 0 | 439 | 26,990 |
| June | 725 | 0 | 165 | 9,818 |
| July | 555 | 0 | 97.6 | 6,001 |
| August | 1,240 | 0 | 138 | 8,485 |
| September | 180 | 0 | 20.5 | 1,220 |
| October | 0 | 0 | 0 | 0 |
| November | 1,250 | 0 | 149 | 8,866 |
| December | 260 | 20 | 85.5 | 5,257 |
| The period | ........ | ........ | ........ | 81,790 |

## TURKEY CREEK NEAR OLUSTEE, OKLA.

This station was established April 20, 1905. It is located about 200 feet downstream from William Fullerton's irrigation dam, 6 miles northwest of Olustee, Okla.

The channel is straight for 200 feet above and below the station. The current is swift. Both banks are high and wooded, but subject to overflow during floods. The bed of the stream is sandy.

Low-water measurements are made by wading at the gage. High-water measurements are made from the highway bridge 1 mile east of the gage.

A staff gage in three sections is fastened to the right bank and trees on the same. An auxiliary gage is located 245 feet below the regular gage, for determinations of slope. During 1905 the gage was read once each day by James R. Craig. Bench marks were established as follows: (1) A group of three nails driven into the root of an elm tree on the right bank, 40 feet above the gage; elevation, 11.65 feet. (2) A point, marked with paint 'U. S. R. S. B. M. 16.29," on a rock 20 feet from the gage; elevation 16.29 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Turkey Creek near Olustee, Okla., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 20 | E. R. Kerby | 15 | 9 | 1.67 | 2.40 | 15 |
| June 5 | do | 15 | 10 | 1.92 | 2.70 | 20 |
| July 18 | do | 11 | 9 | 1.29 | 2.50 | 11 |
| July 22 | do | 10 | 7 | 1.64 | 2.47 | 11 |
| July 22 | do | 10 | 7 | 1.58 | 2.47 | 10 |
| July 30 | do | 16 | 13.5 | .81 | 2.42 | 11 |
| July 31 | J. M. Giles | 16 | 6 | 1.12 | 2.39 | 7 |
| July 31 | E. R. Kerby | 16 | 13.5 | .83 | 2.40 | 11 |
| August 7 | do | 11 | 8 | 1.50 | 2.40 | 12 |
| August 10 | do | | 5.4 | 1.68 | 2.40 | 9 |
| August 11 | do | 15 | 11 | .75 | 2.30 | 8 |
| August 11 | do | 11 | 9 | 1.21 | 2.30 | 11 |
| August 18 | do | | 8 | 1.80 | 2.50 | 15 |
| August 21 | do | 11 | 10 | 1.12 | 2.40 | 11 |
| August 22 | do | 11 | 10 | 1.15 | 2.40 | 12 |
| September 9 | do | | 37 | 1.89 | 3.70 | 71 |
| September 9 | do | 27 | 39 | 1.90 | 3.70 | 74 |
| September 20 | J. M. Giles | 16 | 9 | 1.14 | 2.32 | 10 |
| September 20 | do | 16 | 9 | 1.14 | 2.33 | 10 |
| October 7 | do | 7 | 10 | 2.00 | 2.50 | 21 |
| November 2 | do | | 14 | 1.43 | 2.50 | 20 |
| December 9 | do | | 4.4 | 3.13 | 2.30 | 14 |
| December 30 | do | | 4.8 | 2.90 | 2.30 | 14 |

*Daily gage height, in feet, of Turkey Creek near Olustee, Okla., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 2.2 | ........ | 2.5 | 2.4 | ........ | 2.2 | 2.3 |
| 2 | ........ | 2.2 | ........ | 2.5 | 2.4 | ........ | 2.2 | 2.2 |
| 3 | ........ | 2.2 | ........ | 2.5 | 2.5 | ........ | 2.1 | 2.3 |
| 4 | ........ | 2.2 | ........ | 2.5 | 2.5 | ........ | 2.1 | 2.3 |
| 5 | ........ | 2.2 | 2.7 | 2.6 | 2.4 | ........ | ........ | 2.3 |
| 6 | ........ | 2.2 | 2.6 | 2.6 | 2.3 | ........ | ........ | 2.2 |
| 7 | ........ | 2.1 | 12.2 | 2.6 | 2.4 | ........ | 2.5 | 2.2 |
| 8 | ........ | 2.2 | 10.0 | 2.6 | 2.3 | ........ | 2.5 | 2.3 |
| 9 | ........ | 2.2 | 2.9 | 2.6 | 2.3 | ........ | ........ | 2.3 |
| 10 | ........ | 2.2 | 2.7 | 2.5 | 2.3 | 3.6 | 2.4 | 2.3 |
| 11 | ........ | 2.4 | 2.7 | 2.5 | 2.3 | 4.7 | ........ | 2.3 |
| 12 | ........ | 2.5 | 2.6 | 2.5 | 2.3 | 5.6 | ........ | 2.3 |
| 13 | ........ | 6.2 | 2.7 | 2.5 | 2.4 | 2.7 | ........ | 2.3 |
| 14 | ........ | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | ........ | ........ |
| 15 | ........ | 2.3 | 2.6 | 2.5 | 2.5 | 2.4 | ........ | ........ |
| 16 | ........ | 2.3 | 2.6 | 2.5 | 2.5 | 2.5 | ........ | ........ |
| 17 | ........ | 2.3 | 2.5 | 2.5 | 2.5 | 2.5 | ........ | 2.3 |
| 18 | ........ | 2.2 | 2.6 | 2.5 | 2.5 | 2.5 | ........ | 2.6 |
| 19 | ........ | 2.2 | 2.6 | 2.4 | 2.5 | 2.4 | ........ | 2.3 |
| 20 | 2.4 | 7.1 | 2.6 | 2.4 | 2.5 | 2.5 | ........ | 2.3 |
| 21 | 2.2 | 9.1 | 2.5 | 2.5 | 2.5 | 2.4 | ........ | 2.3 |
| 22 | 2.2 | 13.6 | 2.5 | 2.5 | 2.5 | 2.3 | ........ | 2.3 |
| 23 | 2.7 | 2.7 | 2.6 | 2.5 | 2.3 | 2.2 | ........ | 2.3 |
| 24 | 6.6 | 2.5 | 2.5 | 2.5 | 2.4 | ........ | ........ | 2.2 |
| 25 | 2.6 | 2.5 | 2.5 | 2.6 | 2.3 | 2.1 | ........ | 2.3 |
| 26 | 2.6 | 3.1 | 2.5 | 2.5 | ........ | 2.3 | ........ | 2.3 |
| 27 | 2.4 | ........ | 2.5 | 2.4 | ........ | 2.2 | ........ | 2.2 |
| 28 | 2.3 | ........ | 2.5 | 2.4 | ........ | 3.5 | ........ | 2.2 |
| 29 | 2.2 | ........ | 2.5 | 2.4 | ........ | 3.4 | ........ | 2.2 |
| 30 | 2.2 | ........ | 2.5 | 2.4 | ........ | 2.2 | ........ | 2.2 |
| 31 | ........ | ........ | ........ | 2.4 | ........ | ........ | ........ | 2.4 |

NOTE.—Gage out May 27 to June 4; creek dry September 24, and October 5–6 and 11–21. No readings October 22 to November 23, November 26–30, and December 14–16.

## WASHITA RIVER AT ANADARKO, OKLA.

This station, established October 25, 1902, by W. G. Russell, is located at the highway bridge one-half mile north of the Anadarko railroad depot.

The channel both above and below the station is straight for 200 feet. The right bank is high and the left bank is low. Both banks are liable to overflow. The bed of the stream is sandy and constant.

Discharge measurements are made from the bridge. The initial point for soundings is the right-bank end of the bridge, downstream side.

A standard chain gage is fastened to the hand rail of the bridge; length of chain, 28.17 feet. During 1905 the gage was read once each day by James H. Dunlap. Bench marks were established as follows: (1) A cross cut on the northeast corner of the capstone of the pier on the right bank; elevation, 22.00 feet. (2) A nail in a large cottonwood tree at the south end of the bridge, east of the road; elevation, 24.54 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 139; 99, p 315; 131, p 187.
Discharge: 84, p 139; 99, p 315; 131, p 188.
Discharge, monthly, 131, p 189.
Gage heights: 84, p 140; 99, p 316; 131, p 188.

*Discharge measurements of Washita River at Anadarko, Okla.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 28 | E. R. Kerby | 60 | 94 | 1.47 | 2.8 | 138 |
| April 2 | do | 67 | 171 | 1.34 | 3.20 | 229 |
| April 24 | J. M. Giles | 66 | 150 | 1.47 | 3.30 | 220 |
| April 24 | do | 66 | 153 | 1.43 | 3.30 | 219 |
| April 25 | Murphy and Kerby | 70 | 219 | 1.85 | 4.11 | 405 |
| April 25 | do | 70 | 219 | 1.93 | 4.20 | 424 |
| May 22 | E. R. Kerby | 70 | 322 | 2.55 | 6.35 | 822 |
| June 5 | J. M. Giles | 70 | 360 | 2.25 | 6.50 | 812 |
| June 8 | E. R. Kerby | 70 | 279 | 2.77 | 6.30 | 774 |
| June 21 | do | 70 | 183 | 2.20 | 4.50 | 402 |
| July 3 | do | 69 | 132 | 1.54 | 3.70 | 203 |
| July 10 | do | 68 | 157 | 1.45 | 3.50 | 228 |
| July 24 | J. M. Giles | 70 | 286 | 1.70 | 4.90 | 486 |
| August 28 | E. R. Kerby | 67 | 138 | 1.63 | 3.30 | 225 |
| August 28 | do | 67 | 138 | 1.64 | 3.30 | 226 |
| September 6 | do | ........ | 119 | 1.39 | 2.90 | 166 |
| September 25 | J. M. Giles | ........ | 134 | 1.40 | 3.10 | 187 |
| September 26 | do | ........ | 128 | 1.33 | 3.00 | 171 |
| September 26 | E. R. Kerby | ........ | 130 | 1.44 | 3.00 | 187 |
| September 26 | do | ........ | 130 | 1.43 | 3.00 | 186 |
| October 1 | do | ........ | 94 | 1.43 | 2.60 | 134 |
| October 16 | do | ........ | 93 | 1.08 | 2.50 | 100 |
| October 24 | do | ........ | 92 | 1.16 | 2.50 | 107 |
| November 4 | do | ........ | 92 | 1.13 | 2.50 | 104 |
| November 17 | do | ........ | 137 | 1.28 | 2.80 | 175 |
| November 25 | do | ........ | 129 | 1.26 | 2.70 | 163 |
| November 30 | do | ........ | 222 | 1.66 | 3.80 | 368 |
| November 30 | do | ........ | 219 | 1.60 | 3.70 | 350 |
| December 4 | do | ........ | 185 | 1.44 | 3.20 | 267 |
| December 6 | do | ........ | 154 | 1.35 | 3.05 | 208 |
| December 18 | do | ........ | 142 | 1.20 | 2.90 | 171 |
| December 20 | do | ........ | 139 | 1.24 | 2.85 | 173 |

*Daily gage height, in feet, of Washita River at Anadarko, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.55 | 2.7 | 3.3 | ....... | 4.3 | 18.7 | 3.9 | 3.1 | 3.0 | 2.6 | 2.5 | 3.6 |
| 2 | 2.55 | 2.7 | 3.1 | 3.2 | 4.2 | 14.8 | 3.8 | 4.3 | 2.9 | 2.6 | 2.5 | 3.4 |
| 3 | 2.55 | 2.8 | 3.1 | 3.3 | 4.0 | 12.7 | 3.7 | 3.6 | 2.8 | 2.6 | 2.5 | 3.3 |
| 4 | 2.55 | 2.8 | 3.0 | 5.3 | 3.9 | 9.4 | 3.7 | 3.2 | 2.8 | 2.6 | 2.5 | 3.2 |
| 5 | 2.55 | 2.8 | 3.0 | 4.4 | 3.8 | 6.6 | 3.5 | 3.1 | 2.7 | 2.6 | 2.7 | 3.1 |
| 6 | 2.55 | 2.8 | 3.1 | 4.1 | 3.6 | 6.0 | 3.5 | 3.1 | 2.8 | 2.6 | 3.7 | 3.0 |
| 7 | 2.55 | 2.8 | 3.3 | 3.8 | 3.5 | 5.8 | 3.4 | 3.0 | 3.0 | 2.6 | 3.9 | 3.0 |
| 8 | 2.55 | 2.9 | 3.5 | 3.8 | 3.4 | 5.9 | 3.4 | 2.9 | 3.2 | 2.5 | 3.5 | 3.0 |
| 9 | 2.55 | 2.9 | 3.8 | 3.7 | 3.3 | 6.8 | 3.5 | 2.8 | 4.7 | 2.5 | 3.4 | 2.9 |
| 10 | 2.5 | 2.9 | 4.3 | 3.7 | 3.4 | 7.4 | 3.5 | 2.8 | 7.7 | 2.5 | 3.2 | 2.8 |
| 11 | 2.5 | 2.9 | 3.8 | 7.3 | 3.6 | 9.6 | 3.4 | 2.7 | 8.4 | 2.4 | 3.0 | 2.8 |
| 12 | 2.5 | 2.9 | 3.5 | 8.2 | 3.8 | 7.2 | 3.7 | 2.7 | 8.6 | 2.4 | 3.2 | 2.8 |
| 13 | 2.5 | 2.9 | 3.3 | 6.3 | 5.2 | 5.8 | 3.4 | 2.9 | 5.9 | 2.5 | 3.5 | 2.9 |
| 14 | 2.5 | 2.9 | 3.1 | 4.5 | 8.2 | 5.5 | 3.4 | 3.1 | 7.1 | 2.4 | 3.2 | 2.9 |
| 15 | 2.5 | 2.8 | 3.1 | 3.7 | 10.1 | 5.1 | 3.4 | 4.2 | 4.8 | 2.5 | 2.9 | 2.9 |
| 16 | 2.5 | 2.8 | 3.0 | 3.7 | 7.7 | 5.2 | 3.3 | 9.1 | 4.2 | 2.6 | 2.9 | 2.9 |
| 17 | 2.65 | 2.8 | 3.5 | 3.7 | 6.2 | 5.3 | 3.2 | 9.4 | 3.9 | 2.5 | 2.9 | 2.9 |
| 18 | 2.65 | 2.8 | 4.0 | 3.7 | 5.7 | 5.0 | 3.3 | 9.6 | 3.7 | 2.5 | 2.7 | 2.9 |
| 19 | 2.65 | 2.9 | 4.3 | 3.4 | 4.3 | 4.8 | 3.4 | 6.4 | 3.6 | 2.4 | 2.7 | 2.8 |
| 20 | 2.65 | 2.9 | 4.7 | 3.4 | 4.0 | 4.7 | 3.6 | 6.4 | 3.3 | 2.4 | 2.7 | 2.8 |
| 21 | 2.65 | 3.0 | 5.1 | 3.3 | 5.8 | 4.5 | 3.3 | 6.1 | 3.2 | 2.5 | 2.6 | 2.8 |
| 22 | 2.6 | 3.2 | 6.0 | 3.2 | 6.5 | 4.3 | 3.4 | 4.6 | 3.2 | 2.5 | 2.6 | 2.8 |
| 23 | 2.6 | 3.5 | 5.0 | 3.2 | 6.4 | 4.3 | 5.2 | 4.1 | 3.4 | 2.5 | 2.6 | 2.8 |
| 24 | 2.6 | 3.7 | 3.9 | 3.2 | 6.2 | 4.2 | 5.2 | 3.9 | 3.3 | 2.5 | 2.6 | 2.8 |
| 25 | 2.6 | 4.0 | 3.6 | 4.1 | 5.4 | 4.1 | 4.5 | 3.7 | 3.2 | 2.5 | 2.6 | 2.8 |
| 26 | 2.6 | 4.2 | 3.5 | 6.0 | 5.2 | 4.0 | 4.3 | 3.5 | 3.0 | 2.5 | 2.6 | 2.8 |
| 27 | 2.6 | 3.7 | 3.5 | 10.8 | 12.6 | 4.0 | 4.1 | 3.4 | 2.9 | 3.5 | 2.6 | 2.8 |
| 28 | 2.6 | 3.5 | 3.6 | 11.0 | 14.9 | 4.1 | 3.6 | 3.3 | 2.8 | 2.5 | 6.6 | 2.8 |
| 29 | 2.7 | ....... | 4.6 | 6.2 | 17.0 | 3.9 | 3.4 | 3.2 | 2.7 | 2.5 | 5.0 | 2.8 |
| 30 | 2.7 | ....... | ....... | 5.1 | 18.3 | 3.8 | 3.3 | 3.2 | 2.7 | 2.5 | 4.2 | 2.8 |
| 31 | 2.7 | ....... | ....... | ....... | 18.8 | ....... | 3.2 | 3.1 | ....... | 2.5 | ....... | 2.8 |

NOTE.—Ice conditions January 10-16 and February 3-14; gage heights to top of ice. Gage heights estimated June 3-4 and December 31.

*Daily discharge, in second-feet, of Washita River near Anadarko, Okla., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 105 | 144 | 240 | ....... | 455 | ....... | 254 | 178 | 177 | 134 | 105 | 333 |
| 2 | 105 | 144 | 207 | 229 | 435 | ....... | 227 | 382 | 162 | 134 | 105 | 300 |
| 3 | 105 | ....... | 207 | 240 | 400 | ....... | 203 | 262 | 148 | 134 | 104 | 282 |
| 4 | 105 | ....... | 191 | 600 | 380 | ....... | 218 | 194 | 148 | 134 | 104 | 267 |
| 5 | 105 | ....... | 191 | 430 | 363 | 832 | 184 | 178 | 135 | 134 | 136 | 230 |
| 6 | 105 | ....... | 207 | 378 | 327 | 715 | 198 | 183 | 150 | 134 | 300 | 199 |
| 7 | 105 | ....... | 240 | 325 | 310 | 676 | 180 | 167 | 182 | 134 | 342 | 199 |
| 8 | 105 | ....... | 273 | 325 | 290 | 696 | 197 | 152 | 213 | 105 | 273 | 199 |
| 9 | 105 | ....... | 325 | 295 | 274 | 870 | 214 | 137 | 474 | 105 | 256 | 175 |
| 10 | ....... | ....... | 413 | 295 | 286 | 990 | 228 | 137 | ....... | 105 | 224 | 158 |
| 11 | ....... | ....... | 325 | 990 | 320 | ....... | 213 | 120 | ....... | 90 | 196 | 158 |
| 12 | ....... | ....... | 273 | ....... | 354 | 950 | 262 | 120 | ....... | 90 | 230 | 158 |
| 13 | ....... | ....... | 240 | 775 | 613 | 677 | 213 | 152 | 693 | 100 | 285 | 175 |
| 14 | ....... | ....... | 207 | 440 | ....... | 620 | 213 | 183 | 925 | 85 | 234 | 175 |
| 15 | ....... | 160 | 207 | 295 | ....... | 544 | 213 | 369 | 481 | 100 | 190 | 175 |
| 16 | ....... | 160 | 191 | 295 | ....... | 563 | 203 | ....... | 373 | 115 | 190 | 171 |
| 17 | 136 | 160 | 273 | 284 | 795 | 581 | 186 | ....... | 323 | 100 | 190 | 171 |
| 18 | 136 | 160 | 360 | 284 | 698 | 525 | 203 | ....... | 288 | 100 | 157 | 171 |
| 19 | 136 | 175 | 413 | 234 | 436 | 480 | 220 | 790 | 272 | 85 | 157 | 162 |
| 20 | 136 | 175 | 486 | 234 | 382 | 470 | 252 | 790 | 222 | 85 | 157 | 162 |
| 21 | 136 | 191 | 560 | 220 | 718 | 432 | 203 | 790 | 206 | 107 | 142 | 162 |
| 22 | 130 | 224 | 730 | 202 | 853 | 390 | 224 | 450 | 206 | 107 | 142 | 162 |
| 23 | 130 | 273 | 542 | 202 | 835 | 383 | 544 | 357 | 237 | 107 | 142 | 162 |
| 24 | 130 | 308 | 342 | 202 | 795 | 360 | 544 | 324 | 222 | 107 | 138 | 162 |
| 25 | 130 | 360 | 290 | 405 | 641 | 334 | 412 | 289 | 206 | 107 | 138 | 162 |
| 26 | 130 | 395 | 273 | 780 | 603 | 310 | 377 | 258 | 181 | 107 | 141 | 162 |
| 27 | 130 | 308 | 273 | ....... | ....... | 300 | 341 | 242 | 175 | 106 | 148 | 162 |
| 28 | 130 | 273 | 290 | ....... | ....... | 310 | 255 | 226 | 160 | 106 | 880 | 162 |
| 29 | 144 | ....... | 470 | 820 | ....... | 268 | 227 | 208 | 144 | 106 | 580 | 162 |
| 30 | 144 | ....... | ....... | 603 | ....... | 250 | 210 | 208 | 144 | 105 | 436 | 162 |
| 31 | 144 | ....... | ....... | ....... | ....... | ....... | 196 | 194 | ....... | 105 | ....... | 162 |

NOTE.—The daily discharge was obtained by indirect method. No estimates for ice conditions. No estimate was made for gage heights above 7.5 feet owing to lack of measurements.

*Estimated monthly discharge of Washita River at Anadarko, Okla., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum | Minimum. | Mean. | |
| January 1-9, 17-31 | 144 | 105 | 124 | 5,903 |
| February 1-2, 15-28 | 395 | 144 | 226 | 7,172 |
| March 1-29 | 730 | 191 | 319 | 18,350 |
| April (26 days) | (a) | 202 | 399 | 20,580 |
| May (23 days) | (a) | 274 | 503 | 22,950 |
| June (25 days) | (a) | 250 | 541 | 26,830 |
| July | 544 | 180 | 252 | 15,500 |
| August (28 days) | (a) | 120 | 287 | 15,940 |
| September (27 days) | (a) | 135 | 268 | 14,350 |
| October | 134 | 85 | 109 | 6,702 |
| November | 880 | 104 | 227 | 13,510 |
| December | 333 | 158 | 187 | 11,500 |
| The period | | | | 179,300 |

[a] Discharge beyond limits of rating table.

## OUACHITA RIVER NEAR MALVERN, ARK.

This station was established March 3, 1903, at the Rockport Bridge, 1¾ miles northwest of Malvern, Ark., and was discontinued April 30, 1905. The gage was read by A. M. Baker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 313-314; 131, p 190.
Discharge: 99, p 314; 131, p 190.
Discharge, monthly: 131, p 193.
Gage heights: 99, pp 314-315; 131, p 191.
Rating table: 131, p 192.

*Daily gage height, in feet, of Ouachita River near Malvern, Ark., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.4 | 3.0 | 3.8 | 6.4 | 17 | 5.0 | 3.7 | 3.9 | 6.7 |
| 2 | .3 | 3.9 | 3.7 | 5.4 | 18 | 3.5 | 3.5 | 4.0 | 5.6 |
| 3 | 1.3 | 3.2 | 3.2 | 6.1 | 19 | 3.8 | 4.0 | 4.0 | 5.4 |
| 4 | 1.3 | 2.8 | 3.0 | 12.0 | 20 | 3.8 | 3.7 | 4.0 | 6.5 |
| 5 | 1.2 | 2.6 | 2.9 | 7.9 | 21 | 3.6 | 3.7 | 3.9 | 7.7 |
| 6 | 1.2 | 2.4 | 2.7 | 6.1 | 22 | 3.2 | 4.2 | 3.7 | 7.4 |
| 7 | 1.2 | 2.4 | 2.7 | 5.2 | 23 | 3.0 | 5.0 | 3.5 | 6.0 |
| 8 | 1.0 | 3.0 | 4.6 | 4.7 | 24 | 2.9 | 5.6 | 3.5 | 5.3 |
| 9 | 1.3 | 3.7 | 12.5 | 4.2 | 25 | 2.7 | 5.7 | 3.1 | 7.5 |
| 10 | 2.0 | 4.5 | 15.8 | 3.8 | 26 | 2.5 | 5.4 | 3.0 | 8.3 |
| 11 | 1.9 | 4.9 | 11.2 | 7.5 | 27 | 2.1 | 4.9 | 3.0 | 7.1 |
| 12 | 11.2 | 5.8 | 8.1 | 7.9 | 28 | 2.0 | 4.2 | 2.9 | 6.0 |
| 13 | 10.9 | 6.0 | 6.5 | 6.3 | 29 | 2.4 | ........ | 4.5 | 5.4 |
| 14 | 7.5 | 5.0 | 5.5 | 6.7 | 30 | 2.5 | ........ | 8.4 | 4.6 |
| 15 | 5.2 | 4.7 | 4.8 | 8.6 | 31 | 2.7 | ........ | 8.9 | ........ |
| 16 | 5.1 | 4.0 | 4.2 | 8.5 | | | | | |

## OUACHITA RIVER AT ARKADELPHIA, ARK.

This station was established August 1, 1905, by T. U. Taylor. It is located at the bridge of the St. Louis, Iron Mountain and Southern Railway at Arkadelphia, Ark.

The channel is straight for 500 feet above and 1,200 feet below the station. The current is sluggish at low water. During floods the water spreads out over both banks, but the railroad embankment on the west side forces it through the main channel unless the flood is high enough to flow over the railroad tracks near the passenger depot, one-fourth mile west of the bridge. On the east bank the flood water flows under 73 trestle bents of 12 feet clear space each. The highest water on record occurred in 1882, gage height 27.00 feet.

Discharge measurements are made from the three-span railway bridge. The initial points for soundings are the east faces of the east abutment and each pier, each span being treated as a separate channel.

A standard chain gage is located on the upstream side of the bridge near the middle of the first span from the right bank. During 1905 the gage was read once each day by J. W. Wilson. Bench marks were established as follows: (1) The top of the tie at the gage box; elevation, 35.27 feet. (2) The bridge seat on the north side of the west abutment; elevation, 31.22 feet. (3) A spike in the easternmost of three gum trees about one-eighth mile from the bridge directly across the track from the pumping station of the city waterworks; elevation, 27.00 feet. (4) United States Geological Survey bench mark in the northwest corner of the court-house, marked "246.00;" elevation, 124.57 feet. Elevations refer to the datum of the gage. Bench mark No. 4 is 246.00 feet above sea level.

*Daily gage height, in feet. of Ouachita River at Arkadelphia, Ark., for 1905.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.7 | 2.9 | 2.9 | 4.6 | 7.1 | 17 | 2.8 | 3.4 | 2.9 | 5.5 | 5.2 |
| 2 | 3.8 | 2.9 | 2.9 | 4.3 | 3.4 | 18 | 1.9 | 3.2 | 2.9 | 5.2 | 5.0 |
| 3 | 2.8 | 3.0 | 3.0 | 4.1 | 15.1 | 19 | 1.8 | 3.2 | 3.1 | 4.9 | 5.1 |
| 4 | 2.6 | 2.8 | 3.6 | 4.0 | 10.3 | 20 | 2.2 | 3.2 | 4.7 | 4.7 | 7.4 |
| 5 | 2.3 | 2.8 | 3.9 | 5.1 | 8.3 | 21 | 2.2 | 3.4 | 4.7 | 4.5 | 10.3 |
| 6 | 2.2 | 2.7 | 4.0 | 9.2 | 7.2 | 22 | 2.1 | 3.7 | 4.5 | 4.3 | 10.5 |
| 7 | 2.0 | 2.7 | 3.9 | 8.3 | 6.6 | 23 | 1.8 | 4.0 | 4.2 | 4.2 | 12.7 |
| 8 | 1.9 | 2.9 | 3.7 | 7.2 | 6.1 | 24 | 1.5 | 3.3 | 4.2 | 4.4 | 10.4 |
| 9 | 1.7 | 3.5 | 3.5 | 6.6 | 5.7 | 25 | 1.4 | 3.2 | 6.3 | 4.3 | 8.6 |
| 10 | 1.6 | 3.5 | 3.4 | 11.0 | 5.4 | 26 | 1.4 | 3.1 | 9.5 | 4.6 | 7.5 |
| 11 | 1.5 | 3.3 | 3.3 | 11.7 | 5.1 | 27 | 2.4 | 3.0 | 8.7 | 4.9 | 6.8 |
| 12 | 1.4 | 4.1 | 3.1 | 8.1 | 5.0 | 28 | 3.1 | 3.0 | 6.9 | 4.8 | 8.0 |
| 13 | 1.3 | 4.6 | 3.0 | 8.2 | 4.9 | 29 | 3.0 | 3.0 | 5.8 | 10.7 | 7.7 |
| 14 | 1.6 | 4.3 | 3.0 | 7.0 | 5.2 | 30 | 3.0 | 3.0 | 5.2 | 9.5 | 7.6 |
| 15 | 2.3 | 3.8 | 2.9 | 6.8 | 5.4 | 31 | 2.9 | ...... | 4.9 | ...... | 7.2 |
| 16 | 2.0 | 3.6 | 2.9 | 6.8 | 5.3 | | | | | | |

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# CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 173.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.
2. A certain number are delivered to Senators and Representatives in Congress, for distribution.
3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.
4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

*Series P.*—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco, Cal., 432 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 424 Peyton Block; Pendleton, Oreg.

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WASHINGTON, D. C.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

# REPORT
OF
# PROGRESS OF STREAM MEASUREMENTS
FOR
# THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

## PART X.—Western Gulf of Mexico and Rio Grande Drainages

BY

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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART X.

By T. U. Taylor and John C. Hoyt.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

*Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the Division of Hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The Report of Progress of Stream Measurements, which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico, and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have, in most cases, been redivided, and the facts have been arranged, as far as practicable, geographically.

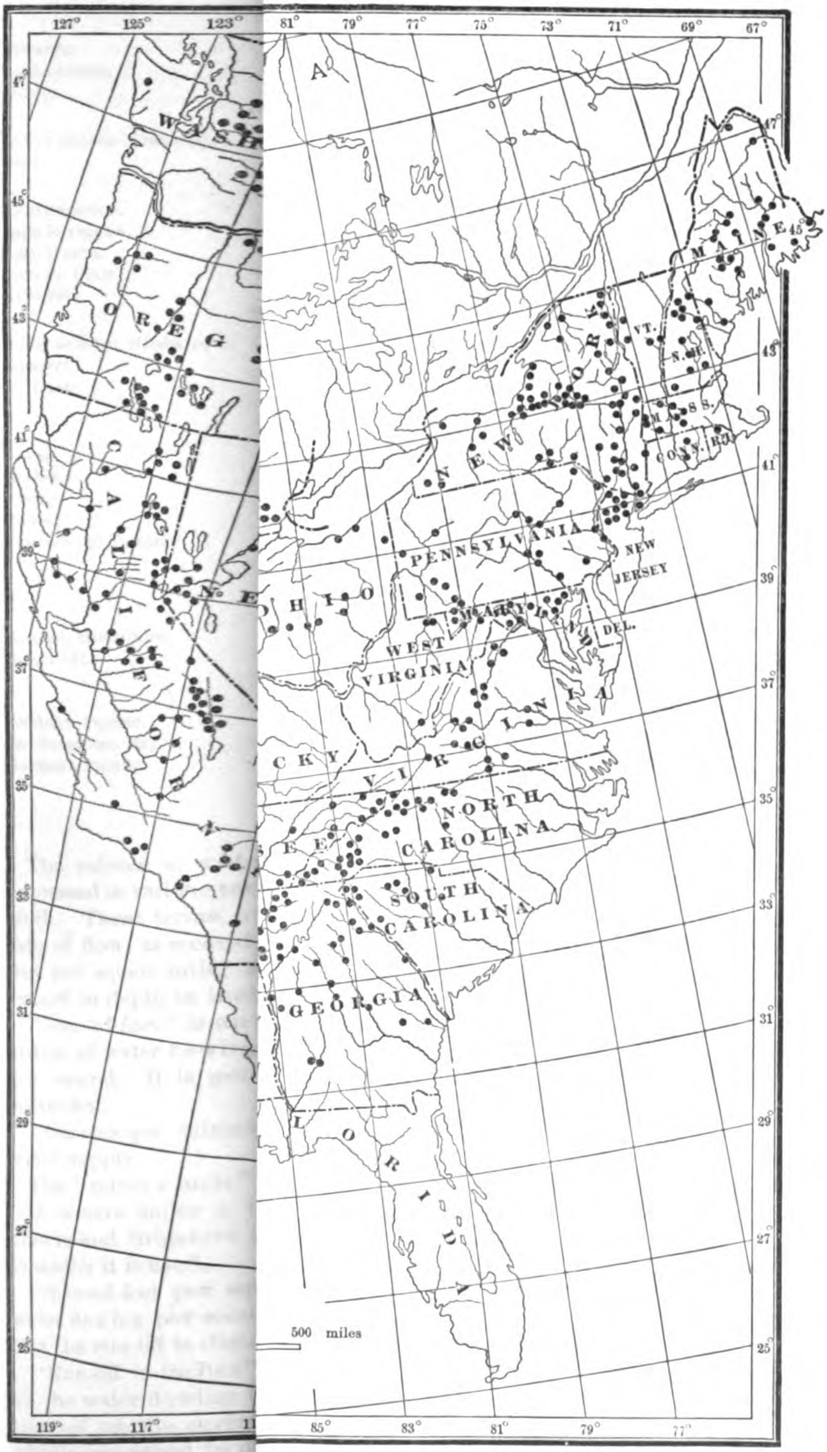
### *List of drainage basins in the United States.*

#### NORTHERN ATLANTIC DRAINAGE BASINS.

St. Johns.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.

#### SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor southern Atlantic.


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
47
45
43
41
39
37
35
33
31
29
27
25
WASH
OREG
CALIFORNIA
N. E
O H I O
C K Y
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
PENNSYLVANIA
NEW YORK
NEW JERSEY
MARYLAND
DEL.
VT.
N. H.
MASS.
CONN.
R. I.
MAINE
A
500 miles
119°
117°
85°
83°
81°
79°
77°

DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadalupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS.

## DEFINITIONS.

The volume of water flowing in a stream—"the run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.
2. All items of computation should be expressed by at least two and not more than four significant figures.
3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.
4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example. 1,828.5 becomes 1,828.

(d) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

### *Special rules for computation.*

1. Rating tables are to be constructed as close as the data upon which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers one square mile 1.131 feet deep, 13.572 inches deep.

1 second-foot for one year eqnals 0.000214 cubic mile; equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot falling 10 feet equals 1.136 horsepower.

100 California miner's inches equal 15 United States gallons per second.

100 California miner's inches equal 77 Colorado miner's inches.

100 California miner's inches for one day equal 4 acre-feet.

100 Colorado miner's inches equal 2.60 second-feet.

100 Colorado miner's inches equal 19.5 United States gallons per second.

100 Colorado miner's inches equal 130 California miner's inches.

100 Colorado miner's inches for one day equal 5.2 acre-feet.

100 United States gallons per minute equal 0.223 second-foot.

100 United States gallons per minute for one day equal 0.44 acre-foot.

1,000,000 United States gallons per day equal 1.55 second-feet.

1,000,000 United States gallons equal 3.07 acre feet.

1,000,000 cubic feet equal 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.

1 inch deep on 1 square mile equals 2,323,200 cubic feet.

1 inch deep on 1 square mile equals 0.0737 second-foot per year.

1 inch equals 2.54 centimeters.

1 foot equals 0.3048 meter.

1 yard equals 0.9144 meter.

1 mile equals 1.60935 kilometers.

1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.

1 square yard equals 0.836 square meter.

1 acre equals 0.4047 hectare.

1 acre equals 43,560 square feet; equals 4,840 square yards.

1 acre equals 209 feet square, nearly.

1 square mile equals 259 hectares.

1 square mile equals 2.59 square kilometers.

1 cubic foot equals 0.0283 cubic meter.

1 cubic foot equals 7.48 gallons; equals 0.804 bushel.

1 cubic foot of water weighs 62.5 pounds.

1 cubic yard equals 0.7646 cubic meter.

1 cubic mile equals 147,198,000,000 cubic feet.

1 cubic mile equals 4,667 second-feet for one year.

1 gallon equals 3.7854 liters.

1 gallon equals 8.36 pounds of water.

1 gallon equals 231 cubic inches (liquid measure).

1 pound equals 0.4536 kilogram.

1 avoirdupois pound equals 7,000 grains.

1 troy pound equals 5,760 grams.

1 meter equals 39.37 inches. Log. 1.5951654.

1 meter equals 3.280833 feet. Log. 0.5159842.

1 meter equals 1.093611 yards. Log. 0.0388629.

1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.

1 hectare equals 2.471 acres.

1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.

1 liter equals 1.0567 quarts.

1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate waterpower quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025 l \sqrt{h^3}$; $l$= length of weir in inches; $h$=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:
Scale 1:125000, 1 mile=0.50688 inch.
Scale 1:90000, 1 mile=0.70400 inch.
Scale 1:62500, 1 mile=1.01376 inches.
Scale 1:45000, 1 mile=1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow, special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general, the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$ which appears therein. The results obtained by the slope method are, in general, only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flashboards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

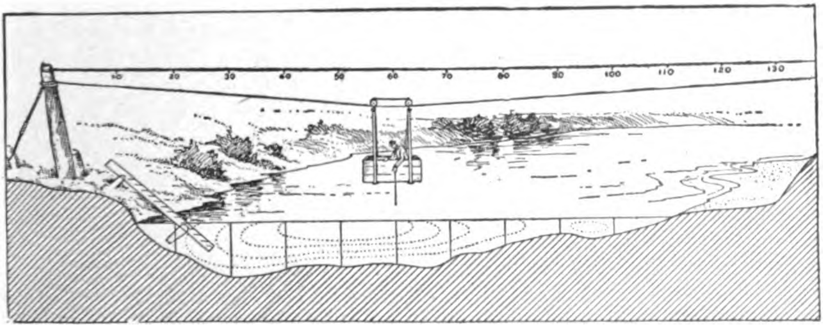


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface float measurements, coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared, which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity curve, 0.2 and 0.8 depth, and top, bottom, and mid depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity curve is a common parabola, with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water Supply Paper No. 146, pp. 141-148.

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads, and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope, due to the rise and fall of the stream, be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity-curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

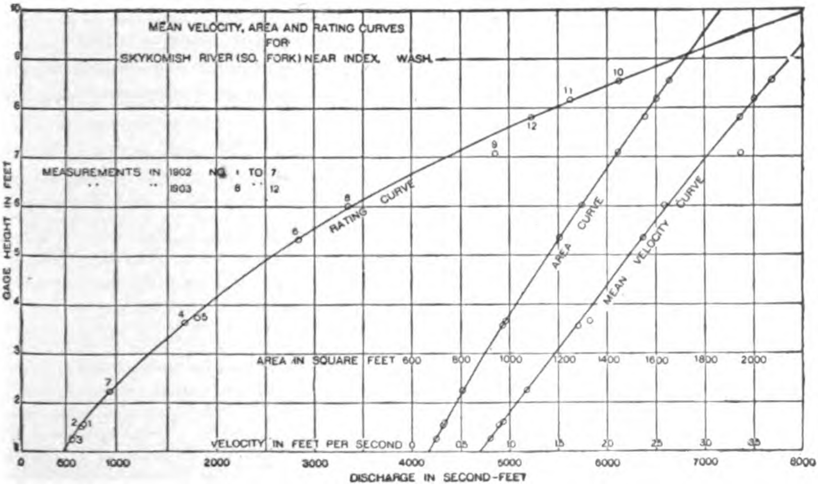


FIG. 2.—Discharge, mean-velocity, and area curves for South Fork of Skykomish River near Index, Wash.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days, and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in Engineering News of April 21, 1904. This method or a graphical application of it is also much used in estimating flow at stations where the bed shifts but slowly.

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The following list, arranged alphabetically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

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*Louisiana.*—District hydrographer, Thomas U. Taylor.[b]

*New Mexico.*[c]—The hydrographic work in the northern portion of this territory was carried on under the direction of M. C. Hinderlider, district hydrographer, assisted as follows: The work in the north central portion was in charge of R. I. Meeker, while the work in the northwestern portion was in charge of O. H. Timmerman. For many favors and courtesies in the form of free accommodations to hydrographers and for assistance in securing records of flow on Mora River acknowledgments are due D. C. Duel, Hugh Loudon, and J. J. Baer, of La Cueva, N. Mex., also to James D. Hand, of Los Alamos, N. Mex., for similar favors. Transportation in the form of annual passes was furnished Mr. Meeker by the Denver and Rio Grande and Atchison, Topeka and Santa Fe railroads. The work in the southern and eastern portion was under the direction of J. M. Giles, assisted by Earl Patterson. Acknowledgments are due the St. Louis and San Francisco, the Chicago, Rock Island and Pacific, the Southern Kansas, the Fort Worth and Denver City, and the Texas and Pacific railroads for transportation furnished Mr. Giles, and the Pecos Valley lines for transportation furnished Mr. Patterson.

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[a] Office of district hydrographer for Colorado, Kansas, Nebraska, northern New Mexico, and Wyoming, Chamber of Commerce Building, Denver, Colo.

[b] Office of the district hydrographer for Texas, Arkansas, and Louisiana, Austin, Tex.

[c] District hydrographer for southern and eastern New Mexico, southern Oklahoma, and southern Indian Territory, J. M. Giles, Carlsbad, N. Mex.

## SABINE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Sabine River has its headwaters in Collin and Hunt counties, Tex., flows in a southeasterly direction to the State line, then south, forming the boundary between Texas and Louisiana, and empties into Sabine Lake, an arm of the Gulf, near Orange, Tex. The small tributaries in eastern Texas support many small water mills, and the Sabine itself is navigable for several hundred miles. The drainage area of the Sabine in Texas above Orange is 7,500 square miles and its total drainage area above Orange in Louisiana and Texas is 10,400 square miles.

### SABINE RIVER NEAR LONGVIEW, TEX.

This station was established January 1, 1904, by Thomas U. Taylor. It is located at the bridge of the International and Great Northern Railroad, about 3 miles southwest of Longview Junction, Tex.

The channel is straight for 150 feet above and 400 feet below the station. The current is sluggish. The right bank is low and cleared along the right of way of the railroad. The left bank is high and composed in its lower half of sandstone; it is cleared above and wooded below the station. The bed of the stream is rocky and fairly permanent. Old piles left from the false work used in erecting the bridge give trouble in making measurements at low water.

Discharge measurements are made from the bridge. The initial point for soundings is the east face of the west abutment.

A standard chain gage is attached to the guard rail of the bridge. During 1905 the gage was read twice each day by John Wadsack. Bench marks were established as follows: (1) The top of abutment, northeast corner, marked "U. S. G. S. 42.08 B. M."; elevation, 42.08 feet. (2) The top of an iron rod buried in a vertical position in the yard of the bridge watchman, 6 feet from the southeast corner of his house, 3 feet from the second post east of the gate, and 8 inches from the wire fence; elevation, 47.00 feet. (3) The top of tie at the gage; elevation, 45.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 322; 132, pp 19–20.
Discharge: 99, p 322; 132, p 20.
Discharge, monthly: 132, p 23.
Gage heights: 132, p 21.
Rating table: 132, p 22.

*Discharge measurements of Sabine River near Longview, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 9 | T. U. Taylor | 3,660 | 3.08 | 30.1 | 11,270 |
| July 10 | do | 4,150 | 3.67 | 32.6 | 15,240 |
| July 11 | do | 4,316 | 3.85 | 33.4 | 16,630 |

*Daily gage height, in feet, of Sabine River near Longview, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8.0 | 7.65 | 16.15 | 17.65 | 28.9 | 32.4 | 24.9 | 25.95 | 7.1 | 7.4 | 12.3 | 9.8 |
| 2 | 7.5 | 7.65 | 15.3 | 18.5 | 30.2 | 31.7 | 23.35 | 26.15 | 7.1 | 7.4 | 11.2 | 10.8 |
| 3 | 7.25 | 7.7 | 13.75 | 23.85 | 31.85 | 31.15 | 21.75 | 26.4 | 7.1 | 7.3 | 10.3 | 10.8 |
| 4 | 7.15 | 7.8 | 11.65 | 24.7 | 32.6 | 30.55 | 22.15 | 26.5 | 7.0 | 7.3 | 9.4 | 10.7 |
| 5 | 7.1 | 7.8 | 10.1 | 24.35 | 32.55 | 29.55 | 24.15 | 26.35 | 6.95 | 7.3 | 9.0 | 11.5 |
| 6 | 7.0 | 7.8 | 9.4 | 23.35 | 32.2 | 28.5 | 25.2 | 25.65 | 6.9 | 7.2 | 9.3 | 12.6 |
| 7 | 7.0 | 8.25 | 9.05 | 22.55 | 32.15 | 26.75 | 26.6 | 23.65 | 6.9 | 7.2 | 9.5 | 13.0 |
| 8 | 6.9 | 10.05 | 9.35 | 21.05 | 32.55 | 24.1 | 28.1 | 19.45 | 6.9 | 7.1 | 9.8 | 13.3 |
| 9 | 6.95 | 11.75 | 10.8 | 21.65 | 33.0 | 20.6 | 29.95 | 15.0 | 7.0 | 7.0 | 10.2 | 13.3 |
| 10 | 7.0 | 12.55 | 13.95 | 21.65 | 23.9 | 15.85 | 32.8 | 11.4 | 7.0 | 6.9 | 10.9 | 12.9 |
| 11 | 7.45 | 12.55 | 14.4 | 22.1 | 34.05 | 11.6 | 33.4 | 10.3 | 6.9 | 6.9 | 11.7 | 12.0 |
| 12 | 9.3 | 12.1 | 14.2 | 22.95 | 34.3 | 9.8 | 33.15 | 9.9 | 6.8 | 6.8 | 12.9 | 11.0 |
| 13 | 11.4 | 11.4 | 15.15 | 23.95 | 33.25 | 9.6 | 32.7 | 9.25 | 6.8 | 6.8 | 14.2 | 12.5 |
| 14 | 11.15 | 10.8 | 15.6 | 24.6 | 34.1 | 9.45 | 32.2 | 8.95 | 6.9 | 6.8 | 15.3 | 15.0 |
| 15 | 10.8 | 10.6 | 16.2 | 24.85 | 33.45 | 9.3 | 31.7 | 8.55 | 6.9 | 6.8 | 16.4 | 16.4 |
| 16 | 10.25 | 10.75 | 17.15 | 24.7 | 33.1 | 9.4 | 31.25 | 8.35 | 6.9 | 6.7 | 17.1 | 17.8 |
| 17 | 9.4 | 11.05 | 17.4 | 23.45 | 33.6 | 9.25 | 31.1 | 8.15 | 6.9 | 6.9 | 17.7 | 19.4 |
| 18 | 9.0 | 11.3 | 20.45 | 21.65 | 34.9 | 9.05 | 31.1 | 7.95 | 6.8 | 7.1 | 18.2 | 21.3 |
| 19 | 8.85 | 13.95 | 27.8 | 21.95 | 35.05 | 9.7 | 31.15 | 7.8 | 6.9 | 7.2 | 18.7 | 25.6 |
| 20 | 9.35 | 17.15 | 27.45 | 23.2 | 34.9 | 10.5 | 30.7 | 7.7 | 7.05 | 7.9 | 18.9 | 28.2 |
| 21 | 9.3 | 17.75 | 27.15 | 24.15 | 34.45 | 10.2 | 30.25 | 7.55 | 7.55 | 9.1 | 18.6 | 28.4 |
| 22 | 8.95 | 17.05 | 27.05 | 24.15 | 34.05 | 11.15 | 29.65 | 7.4 | 8.05 | 10.6 | 17.0 | 29.4 |
| 23 | 8.45 | 16.35 | 26.25 | 23.85 | 33.55 | 16.0 | 29.4 | 7.4 | 7.95 | 11.9 | 14.0 | 30.0 |
| 24 | 8.05 | 16.0 | 25.0 | 24.0 | 33.4 | 13.85 | 28.35 | 7.3 | 7.7 | 12.1 | 11.1 | 33.6 |
| 25 | 7.8 | 16.9 | 23.45 | 27.15 | 33.6 | 13.7 | 27.15 | 7.25 | 7.95 | 11.7 | 9.7 | 33.8 |
| 26 | 7.7 | 16.05 | 21.6 | 27.65 | 34.25 | 15.05 | 26.1 | 7.25 | 7.95 | 10.2 | 9.3 | 33.6 |
| 27 | 7.55 | 16.35 | 19.4 | 27.5 | 34.7 | 21.6 | 25.5 | 7.1 | 7.8 | 9,5 | 9.1 | 33.2 |
| 28 | 7.5 | 16.45 | 16.1 | 27.5 | 34.65 | 27.15 | 25.05 | 7.1 | 7.7 | 10.1 | 9.0 | 32.8 |
| 29 | 7.4 | ....... | 17.2 | 27.6 | 34.25 | 26.95 | 25.0 | 7.05 | 7.6 | 11.9 | 8.9 | 32.3 |
| 30 | 7.7 | ....... | 18.65 | 28.15 | 33.65 | 26.15 | 25.25 | 7.0 | 7.45 | 13.2 | 8.9 | 31.8 |
| 31 | 7.65 | ....... | 18.55 | ....... | 33.05 | ....... | 25.55 | 7.0 | ....... | 13.4 | ....... | 30.4 |

*Station rating table for Sabine River near Longview, Tex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.00 | 44 | 7.90 | 300 | 9.80 | 660 | 13.40 | 1,461 |
| 6.10 | 53 | 8.00 | 317 | 9.90 | 680 | 13.60 | 1,509 |
| 6.20 | 63 | 8.10 | 335 | 10.00 | 700 | 13.80 | 1,557 |
| 6.30 | 74 | 8.20 | 353 | 10.20 | 742 | 14.00 | 1,605 |
| 6.40 | 85 | 8.30 | 371 | 10.40 | 784 | 14.20 | 1,653 |
| 6.50 | 97 | 8.40 | 389 | 10.60 | 826 | 14.40 | 1,701 |
| 6.60 | 109 | 8.50 | 407 | 10.80 | 869 | 14.60 | 1,750 |
| 6.70 | 122 | 8.60 | 426 | 11.00 | 913 | 14.80 | 1,800 |
| 6.80 | 135 | 8.70 | 445 | 11.20 | 957 | 15.00 | 1,850 |
| 6.90 | 148 | 8.80 | 464 | 11.40 | 1,001 | 15.50 | 1,975 |
| 7.00 | 162 | 8.90 | 483 | 11.60 | 1,045 | 16.00 | 2,103 |
| 7.10 | 176 | 9.00 | 502 | 11.80 | 1,090 | 16.50 | 2,233 |
| 7.20 | 190 | 9.10 | 521 | 12.00 | 1,136 | 17.00 | 2,366 |
| 7.30 | 205 | 9.20 | 540 | 12.20 | 1,182 | 18.00 | 2,640 |
| 7.40 | 220 | 9.30 | 560 | 12.40 | 1,228 | 19.00 | 2,938 |
| 7.50 | 235 | 9.40 | 580 | 12.60 | 1,274 | 20.00 | 3,310 |
| 7.60 | 251 | 9.50 | 600 | 12.80 | 1,320 | 21.00 | 3,746 |
| 7.70 | 267 | 9.60 | 620 | 13.00 | 1,366 | 22.00 | 4,230 |
| 7.80 | 283 | 9.70 | 640 | 13.20 | 1,413 | | |

The above table is based on 23 discharge measurements made during 1904 and 3 made during 1905. It is well defined between gage heights 6 feet and 22 feet. Above 22 feet the discharge is only approximate. Below 19 feet the table is the same as for 1904.

*Estimated monthly discharge of Sabine River near Longview, Tex., for 1905.*

[Drainage area, 2,900 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,001 | 148 | 385 | 23,670 | 0.133 | 0.153 |
| February | 2,570 | 259 | 1,251 | 69,480 | .431 | .449 |
| March | 8,490 | 512 | 3,134 | 192,700 | 1.08 | 1.24 |
| April | 8,865 | 2,542 | 5,511 | 327,900 | 1.90 | 2.12 |
| May | 19,480 | 9,735 | 16,640 | 1,023,000 | 5.74 | 6.62 |
| June | 14,980 | 512 | 4,470 | 266,000 | 1.54 | 1.72 |
| July | 16,680 | 4,106 | 9,777 | 601,200 | 3.37 | 3.88 |
| August | 7,316 | 162 | 1,934 | 118,900 | .667 | .769 |
| September | 326 | 135 | 195 | 11,600 | .067 | .075 |
| October | 1,461 | 122 | 461 | 28,350 | .159 | .183 |
| November | 2,907 | 483 | 1,332 | 81,900 | .459 | .512 |
| December | 17,360 | 660 | 6,388 | 392,800 | 2.20 | 2.54 |
| The year | 19,480 | 122 | 4,290 | 3,138,000 | 1.48 | 20.26 |

## NECHES RIVER AT EVADALE, TEX.

A gaging station was established on Neches River at Evadale July 1, 1904, by Thomas U. Taylor. It is located at the bridge of the Gulf, Beaumont and Kansas City Railway.

The clear span or water way under each arm of the draw span is 50 feet, and the bridge continues each way on trestles. The left bank is high, whence the name of the railroad station, Fords Bluff, but the right or west bank is low and the trestle work continues about half a mile from the river channel.

Discharge measurements are made from the bridge at ordinary and high stages. At low water the current is very sluggish, and discharge measurements are made at shoals above or below the station.

Gage readings are made by reading down from the top of the tie to the water surface by means of a tape. The zero of the gage is 40.00 feet below the top of the tie in the west arm of the draw span of the bridge. During 1905 the gage was read by W. H. Whittemore.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132 of the United States Geological Survey, pages 23-24.

*Discharge measurements of Neches River at Evadale, Tex., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-feet.* |
| March 27 | H. H. Fox | 21.6 | 13,730 |
| March 29 | do | 22.1 | 14,240 |
| June 24 | T. U. Taylor | 15.2 | 3,389 |
| July 3 | do | 18.1 | 7,130 |

*Daily gage height, in feet, of Neches River at Evadale, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19.2 | 16.6 | 19.4 | 21.5 | 21.0 | 22.1 | 20.0 | 18.7 | 11.1 | 7.9 | 8.6 | 14.7 |
| 2 | 19.2 | 16.6 | 19.3 | 21.3 | 21.1 | 21.9 | 18.4 | 18.2 | 10.8 | 7.9 | 8.6 | 14.1 |
| 3 | 19.0 | 17.2 | 19.2 | 21.1 | 21.3 | 21.7 | 17.8 | 17.6 | 10.3 | 7.8 | 8.7 | 13.3 |
| 4 | 18.5 | 17.0 | 19.1 | 21.1 | 21.5 | 21.7 | 17.5 | 17.1 | 10.0 | 7.8 | 8.8 | 13.6 |
| 5 | 18.0 | 16.5 | 19.0 | 21.4 | 21.8 | 21.6 | 17.2 | 16.9 | 10.0 | 7.8 | 9.2 | 14.1 |
| 6 | 17.8 | 16.0 | 18.8 | 21.6 | 21.8 | 21.5 | 17.3 | 16.8 | 9.6 | 7.8 | 9.6 | 14.1 |
| 7 | 17.8 | 16.0 | 18.7 | 21.8 | 21.8 | 21.3 | 17.5 | 17.1 | 10.3 | 7.8 | 10.0 | 14.1 |
| 8 | 17.9 | 16.6 | 18.5 | 22.0 | 21.8 | 21.1 | 17.9 | 18.6 | 11.8 | 7.8 | 11.4 | 14.2 |
| 9 | 17.9 | 17.0 | 18.3 | 22.3 | 21.7 | 20.6 | 18.7 | 19.0 | 11.3 | 7.8 | 12.8 | 14.3 |
| 10 | 17.9 | 17.3 | 18.2 | 22.5 | 21.7 | 20.0 | 19.4 | 19.3 | 10.6 | 7.7 | 13.9 | 14.0 |
| 11 | 17.8 | 17.7 | 19.6 | 22.6 | 21.7 | 19.2 | 19.7 | 19.2 | 10.0 | 7.7 | 15.1 | 14.0 |
| 12 | 17.7 | 18.0 | 19.1 | 22.6 | 21.8 | 18.1 | 20.0 | 19.2 | 9.4 | 7.6 | 16.0 | 14.1 |
| 13 | 17.5 | 18.5 | 19.4 | 22.5 | 21.9 | 17.2 | 20.3 | 19.2 | 9.1 | 7.6 | 16.9 | 14.5 |
| 14 | 17.3 | 19.0 | 19.7 | 22.3 | 22.0 | 16.8 | 20.7 | 19.1 | 9.0 | 7.5 | 17.2 | 14.8 |
| 15 | 17.5 | 19.6 | 19.9 | 22.0 | 22.0 | 16.1 | 20.9 | 18.9 | 9.0 | 7.4 | 18.0 | 15.2 |
| 16 | 17.2 | 19.3 | 19.7 | 21.7 | 22.1 | 15.7 | 21.1 | 18.5 | 9.1 | 7.5 | 18.0 | 16.6 |
| 17 | 17.5 | 19.3 | 19.6 | 21.5 | 22.2 | 15.4 | 21.4 | 17.8 | 8.7 | 7.5 | 17.9 | 16.8 |
| 18 | 16.7 | 19.0 | 19.6 | 21.3 | 22.3 | 15.2 | 21.6 | 17.0 | 8.5 | 7.4 | 17.9 | 17.0 |
| 19 | 15.9 | 18.6 | 19.9 | 21.1 | 22.6 | 14.9 | 21.7 | 16.1 | 8.5 | 7.4 | 17.7 | 17.1 |
| 20 | 15.0 | 18.4 | 20.2 | 21.0 | 22.9 | 14.5 | 21.9 | 15.4 | 8.5 | 7.4 | 17.5 | 17.2 |
| 21 | 14.7 | 18.4 | 20.5 | 20.9 | 23.1 | 14.0 | 21.8 | 14.7 | 8.5 | 7.2 | 17.6 | 17.2 |
| 22 | 14.6 | 19.0 | 20.8 | 20.6 | 23.4 | 13.4 | 21.6 | 14.1 | 8.4 | 7.2 | 17.6 | 18.0 |
| 23 | 14.3 | 19.4 | 21.0 | 20.4 | 23.6 | 13.7 | 21.4 | 13.6 | 8.4 | 7.2 | 17.7 | 18.4 |
| 24 | 14.1 | 19.6 | 21.1 | 20.5 | 23.6 | 14.6 | 21.2 | 13.1 | 8.4 | 7.0 | 17.5 | 18.6 |
| 25 | 14.0 | 19.5 | 21.5 | 20.4 | 23.5 | 17.9 | 21.1 | 12.5 | 8.4 | 7.0 | 17.4 | 19.1 |
| 26 | 13.7 | 19.7 | 21.5 | 20.3 | 23.3 | 18.5 | 20.7 | 11.9 | 8.3 | 7.3 | 17.1 | 19.7 |
| 27 | 13.6 | 19.7 | 21.6 | 20.3 | 23.1 | 18.7 | 20.4 | 11.4 | 8.2 | 7.6 | 16.7 | 19.9 |
| 28 | 13.6 | 19.6 | 21.7 | 20.3 | 23.0 | 19.1 | 20.1 | 11.0 | 8.1 | 7.9 | 16.1 | 20.1 |
| 29 | 13.4 | ....... | 21.8 | 20.4 | 22.7 | 19.3 | 19.9 | 10.6 | 8.0 | 8.0 | 15.7 | 19.3 |
| 30 | 13.1 | ....... | 21.8 | 20.8 | 22.5 | 19.1 | 19.2 | 10.8 | 7.9 | 8.3 | 15.2 | 19.8 |
| 31 | 15.0 | ....... | 21.6 | ....... | 22.4 | ....... | 19.5 | 11.4 | ....... | 8.6 | ....... | 20.0 |

*Station rating table for Neches River at Evadale, Tex., from July 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.00 | 180 | 6.70 | 429 | 8.80 | 854 | 12.00 | 1,800 |
| 5.10 | 191 | 6.80 | 447 | 9.00 | 900 | 12.50 | 2,010 |
| 5.20 | 202 | 6.90 | 465 | 9.20 | 948 | 13.00 | 2,248 |
| 5.30 | 214 | 7.00 | 484 | 9.40 | 997 | 13.50 | 2,508 |
| 5.40 | 226 | 7.10 | 503 | 9.60 | 1,047 | 14.00 | 2,790 |
| 5.50 | 239 | 7.20 | 522 | 9.80 | 1,098 | 14.50 | 3,110 |
| 5.60 | 252 | 7.30 | 541 | 10.00 | 1,150 | 15.00 | 3,480 |
| 5.70 | 266 | 7.40 | 560 | 10.20 | 1,204 | 15.50 | 3,890 |
| 5.80 | 280 | 7.50 | 580 | 10.40 | 1,260 | 16.00 | 4,350 |
| 5.90 | 295 | 7.60 | 600 | 10.60 | 1,318 | 17.00 | 5,410 |
| 6.00 | 310 | 7.70 | 620 | 10.80 | 1,378 | 18.00 | 6,660 |
| 6.10 | 326 | 7.80 | 640 | 11.00 | 1,442 | 19.00 | 8,270 |
| 6.20 | 342 | 7.90 | 660 | 11.20 | 1,509 | 20.00 | 10,100 |
| 6.30 | 359 | 8.00 | 680 | 11.40 | 1,578 | 21.00 | 12,090 |
| 6.40 | 376 | 8.20 | 722 | 11.60 | 1,650 | 22.00 | 14,300 |
| 6.50 | 393 | 8.40 | 765 | 11.80 | 1,724 | 23.00 | 16,750 |
| 6.60 | 411 | 8.60 | 809 | | | | |

The above table is based on seven discharge measurements made during 1904-5. It is fairly well defined between gage heights 5.6 feet and 22 feet. Above 22 feet the discharge is approximate.

*Estimated monthly discharge of Neches River at Evadale, Tex., for 1904 and 1905.*

[Drainage area, 8,200 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| **1904.** | | | | | | |
| July | 1,232 | 503 | 1,027 | 63,150 | 0.125 | 0.144 |
| August | 1,922 | 411 | 879 | 54,050 | .107 | .123 |
| September | 640 | 326 | 463 | 27,550 | .056 | .062 |
| October | 503 | 202 | 291 | 17,890 | .035 | .040 |
| November | 266 | 202 | 209 | 12,440 | .025 | .028 |
| December | 7,590 | 280 | 1,043 | 64,130 | .127 | .146 |
| The period | ........ | ........ | ........ | 239,200 | ........ | ........ |
| **1905.** | | | | | | |
| January | 8,620 | 2,298 | 5,090 | 313,000 | .621 | .716 |
| February | 9,530 | 4,350 | 7,171 | 398,300 | .875 | .911 |
| March | 13,840 | 6,960 | 10,210 | 627,800 | 1.25 | 1.44 |
| April | 15,750 | 10,670 | 12,870 | 765,800 | 1.57 | 1.75 |
| May | 18,300 | 12,090 | 15,070 | 926,600 | 1.84 | 2.12 |
| June | 14,540 | 2,454 | 7,865 | 468,000 | .959 | 1.07 |
| July | 14,070 | 5,640 | 10,180 | 625,900 | 1.24 | 1.43 |
| August | 8,800 | 1,318 | 5,127 | 315,200 | .625 | .721 |
| September | 1,724 | 660 | 986 | 58,670 | .120 | .134 |
| October | 809 | 484 | 606 | 37,260 | .074 | .085 |
| November | 6,660 | 809 | 4,217 | 250,900 | .514 | .574 |
| December | 10,290 | 2,402 | 5,312 | 326,600 | .648 | .747 |
| The year | 18,300 | 484 | 7,059 | 5,114,000 | .861 | 11.70 |

## TRINITY RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Trinity River rises in a network of small streams in the counties of Montague, Jack, Wise, Denton, and Parker, Tex., but their combined flow above Dallas is not sufficient to keep the bottom or bed of the stream moist in dry times. Below Dallas the Trinity flows through a wooded country, and consequently it is not subject to sudden floods with their quick run-offs.

### TRINITY RIVER AT RIVERSIDE, TEX.

A gaging station was established on Trinity River at Riverside, Tex., in December, 1902, by Thomas U. Taylor. It is located at the bridge of the International and Great Northern Railroad.

The channel is straight for 300 feet above and 1,000 feet below the bridge. The current is sluggish at low and swift at high stages. The right bank is high and rocky. The left bank is lower than the right, a trestle being used to measure the overflow at flood stages. The bed of the stream consists of tough mud or clay.

Discharge measurements are made from the railroad bridge. The initial point for soundings is the north face of the south abutment for the south channel. For the north channel the north face of the pier is the initial point.

During 1905 the gage was read by G. W. Higdon. The zero of the gage is 66.00 feet below the top of the ties (or base of rail) in the north arm of the draw span of the International and Great Northern Railroad bridge. The elevation of the top of the pivot pier above gage datum is 56.50 feet, and that of the top of the channel of the lower chord of the arms of the draw span of the bridge is 62.90 feet. According to the survey of the United States Army engineers the elevation of the top of the tie with reference to mean low tide of the gulf is 148.70 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, pp 142-143; 99, pp 322-323; 132, p 25.
Discharge: 84, p 143; 99, p 323; 132, p 26.
Discharge, monthly: 99, p 325; 132, p 28.
Gage heights: 99, pp 323-324; 132, p 26.
Rating table: 99, p 324; 132, p 27.

*Discharge measurements of Trinity River at Riverside, Tex., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| July 4 | T. U. Taylor | 37.6 | 24,600 |
| July 4 | .....do | 37.0 | 23,800 |
| July 5 | .....do | 35.8 | 21,420 |
| July 5 | .....do | 34.8 | 20,490 |
| July 6 | H. H. Fox | 32.7 | 18,970 |
| July 7 | .....do | 31.5 | 17,890 |
| July 8 | .....do | 30.2 | 17,320 |

*Daily gage height, in feet, of Trinity River at Riverside, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10.4 | 9.2 | 17.9 | 28.5 | 42.5 | 49.1 | 45.7 | 34.4 | 10.4 | 8.5 | 11.5 | 11.2 |
| 2 | 9.5 | 9.5 | 15.4 | 25.6 | 43.1 | 48.6 | 44.0 | 34.4 | 10.1 | 8.4 | 11.2 | 12.0 |
| 3 | 9.1 | 9.5 | 12.7 | 29.2 | 42.9 | 48.0 | 41.6 | 34.3 | 9.3 | 8.3 | 10.5 | 12.2 |
| 4 | 8.9 | 9.4 | 11.4 | 29.2 | 41.4 | 47.4 | 38.5 | 33.7 | 9.1 | 8.3 | 10.3 | 11.9 |
| 5 | 8.8 | 9.4 | 10.7 | 29.0 | 39.4 | 46.9 | 35.8 | 33.7 | 8.9 | 8.2 | 10.2 | 11.5 |
| 6 | 8.6 | 9.4 | 10.2 | 28.6 | 37.7 | 46.4 | 33.5 | 32.2 | 8.9 | 8.1 | 10.3 | 11.1 |
| 7 | 8.5 | 9.7 | 10.0 | 27.5 | 36.3 | 46.1 | 31.8 | 31.9 | 8.9 | 8.1 | 11.1 | 12.5 |
| 8 | 8.4 | 10.7 | 10.0 | 26.6 | 35.8 | 45.9 | 30.3 | 31.4 | 8.8 | 8.0 | 12.3 | 12.7 |
| 9 | 8.4 | 13.2 | 22.8 | 26.2 | 36.4 | 45.9 | 32.4 | 30.9 | 8.7 | 8.0 | 12.6 | 12.4 |
| 10 | 8.4 | 13.6 | 15.4 | 26.2 | 38.0 | 45.9 | 34.3 | 29.9 | 8.7 | 10.0 | 17.5 | 11.7 |
| 11 | 8.3 | 13.3 | 16.4 | 26.2 | 38.6 | 45.8 | 35.2 | 28.5 | 8.6 | 13.0 | 17.6 | 11.0 |
| 12 | 9.5 | 14.0 | 23.3 | 26.7 | 39.0 | 45.6 | 35.7 | 26.3 | 8.5 | 13.5 | 17.9 | 10.5 |
| 13 | 11.7 | 14.3 | 20.1 | 27.2 | 39.6 | 45.0 | 35.5 | 18.7 | 8.5 | 12.9 | 17.7 | 10.5 |
| 14 | 11.4 | 15.0 | 18.8 | 27.7 | 40.6 | 44.2 | 34.5 | 14.0 | 8.4 | 11.9 | 17.3 | 12.8 |
| 15 | 10.6 | 15.1 | 19.4 | 27.8 | 43.3 | 43.6 | 33.7 | 11.9 | 8.4 | 10.7 | 17.9 | 17.2 |
| 16 | 9.9 | 14.5 | 20.0 | 27.8 | 46.6 | 41.8 | 32.7 | 11.4 | 8.4 | 10.0 | 17.7 | 18.6 |
| 17 | 10.0 | 13.6 | 20.0 | 27.8 | 48.5 | 38.0 | 31.9 | 11.2 | 8.3 | 9.4 | 19.4 | 20.0 |
| 18 | 11.9 | 12.5 | 22.6 | 27.4 | 49.8 | 29.7 | 31.0 | 11.2 | 8.3 | 9.0 | 19.5 | 20.5 |
| 19 | 12.7 | 15.7 | 27.0 | 27.2 | 50.0 | 19.7 | 31.0 | 11.0 | 8.2 | 8.9 | 19.7 | 22.5 |
| 20 | 12.7 | 19.7 | 27.3 | 26.7 | 52.4 | 15.7 | 29.5 | 10.5 | 8.7 | 9.2 | 19.6 | 26.7 |
| 21 | 11.9 | 19.4 | 28.1 | 25.4 | 48.9 | 14.0 | 32.1 | 10.3 | 9.0 | 13.5 | 19.4 | 29.8 |
| 22 | 10.9 | 19.9 | 29.2 | 22.1 | 48.0 | 16.4 | 29.0 | 10.0 | 9.0 | 14.1 | 18.7 | 31.9 |
| 23 | 10.2 | 18.9 | 27.5 | 18.3 | 47.1 | 18.8 | 29.2 | 10.0 | 9.2 | 13.8 | 17.1 | 32.5 |
| 24 | 9.7 | 18.0 | 26.7 | 17.4 | 46.2 | 18.8 | 30.0 | 10.0 | 9.2 | 14.0 | 15.7 | 32.3 |
| 25 | 8.7 | 18.0 | 27.2 | 32.9 | 46.5 | 18.1 | 30.1 | 9.7 | 9.7 | 14.7 | 15.7 | 31.8 |
| 26 | 9.1 | 18.5 | 26.4 | 36.4 | 46.6 | 18.8 | 30.5 | 9.7 | 9.8 | 14.2 | 14.7 | 31.5 |
| 27 | 9.0 | 18.8 | 28.2 | 37.7 | 47.7 | 37.7 | 30.5 | 9.5 | 9.5 | 13.2 | 14.1 | 31.5 |
| 28 | 8.9 | 18.6 | 29.0 | 36.3 | 48.9 | 44.8 | 31.0 | 8.4 | 9.3 | 12.2 | 13.6 | 32.0 |
| 29 | 8.8 | ....... | 32.1 | 34.2 | 47.7 | 47.0 | 33.8 | 8.3 | 9.0 | 12.4 | 12.6 | 32.3 |
| 30 | 8.8 | ....... | 31.1 | 40.6 | 49.9 | 46.8 | 34.1 | 8.3 | 8.7 | 12.2 | 11.8 | 32.7 |
| 31 | 8.8 | ....... | 30.3 | ....... | 48.7 | ....... | 34.1 | 10.6 | ....... | 12.5 | ....... | 33.6 |

*Estimated monthly discharge of Trinity River at Riverside, Tex., for 1905.*

[Drainage area, 16,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,779 | 441 | 1,108 | 68,130 | 0.069 | 0.080 |
| February | 8,081 | 761 | 4,064 | 225,700 | .254 | .264 |
| March | 18,580 | 1,150 | 9,716 | 597,400 | .607 | .700 |
| April | 26,730 | 6,138 | 15,310 | 911,000 | .957 | 1.07 |
| May | 38,500 | 22,020 | 30,260 | 1,861,000 | 1.89 | 2.18 |
| June | 35,200 | 3,630 | 24,180 | 1,439,000 | 1.51 | 1.68 |
| July | 31,800 | 15,780 | 20,070 | 1,234,000 | 1.25 | 1.44 |
| August | 20,680 | 441 | 8,136 | 500,300 | .508 | .586 |
| September | 1,375 | 413 | 682 | 40,580 | .043 | .048 |
| October | 4,127 | 360 | 1,848 | 113,600 | .116 | .134 |
| November | 7,923 | 1,261 | 4,613 | 274,500 | .288 | .321 |
| December | 19,950 | 1,433 | 9,270 | 570,000 | .579 | .668 |
| The year | 38,500 | 360 | 10,770 | 7,835,000 | .673 | 9.17 |

NOTE.—Above estimates subject to large error for low and medium stages owing to the inconsistent data on which the rating table was based.

## BRAZOS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

This river has its source in the Staked Plains region of western Texas and has a general southeasterly course, emptying into the Gulf of Mexico south of the mouth of Trinity River. Its drainage basin is entirely within the State of Texas.

### BRAZOS RIVER AT WACO, TEX.

This station was established September 14, 1898, by Thomas U. Taylor. It is located at the suspension bridge on Bridge street, Waco, Tex.

The channel is straight for 1,000 feet above and 300 feet below the station. There is a good current at all stages. The right bank is composed of limestone and does not overflow. The left bank is high, but overflows during floods. The bed of the stream is composed of sand, free from vegetation, and slightly shifting. A single-span truss bridge crosses the river at an angle of 76° about 300 feet above the suspension bridge.

Discharge measurements are made from the suspension bridge. The initial point for soundings is the edge of the right abutment.

An inclined gage in three sections is located on the left bank under the bridge. During 1905 the gage was read twice each day by W. J. Cassaday. Bench marks were established as follows: (1) The top of the water table on the top of the south pier of the abutment of the suspension bridge, about 3 inches above the floor, marked "U. S. G. S. B. M."; elevation, 44.33 feet above the datum of the gage. (2) United States Coast and Geodetic Survey bolt in the side of Patton's feed store; elevation, 55.60 feet above the datum of the gage and 413.18 feet above mean low tide. (3) The floor of the truss bridge above the suspension bridge, at the foot of the downstream batter brace on the Waco side; elevation, 45.40 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 28, p 118; 37, p 272; 50, p 333; 66, p 58–59; 84, pp 143–144; 99, pp 325–326; 132, pp 28–29.
Discharge: 28, p 129; 37, p 272; 50, p 334; 66, p 59; 84, pp 144–145; 99, p 327; 132, p 30.
Discharge, monthly: 75, pp 150–151; 84, p 146; 99, p 328; 132, p 31.
Gage heights: 28, p 121; 37, p 273; 50, p 334; 66, p 59; 84, p 145; 99, p 327; 132, p 30.
Rating tables: 66, p 173; 84, p 146; 99, p 328; 132, p 31.

### *Discharge measurements of Brazos River at Waco, Tex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 1[a] | W. J. Cassaday | 450 | 11,350 | 7.75 | 29.0 | 88,000 |
| May 2 | H. H. Fox | 450 | 4,055 | 4.02 | 12.5 | 16,320 |
| May 2 | do | 450 | 3,540 | 3.78 | 11.4 | 13,400 |
| May 2 | do | 450 | 4,660 | 4.22 | 13.9 | 19,680 |
| May 3 | do | 440 | 2,800 | 3.40 | 9.7 | 9,520 |
| May 3 | do | 445 | 3,100 | 3.51 | 10.4 | 10,880 |
| May 4 | do | 440 | 2,390 | 3.26 | 8.8 | 7,780 |
| May 8 | do | 480 | 10,420 | 7.11 | 26.7 | 74,110 |
| May 9 | do | 460 | 6,820 | 5.59 | 18.8 | 38,090 |
| May 9 | do | 450 | 5,210 | 4.44 | 15.3 | 23,140 |
| August 10 | T. U. Taylor | 380 | 1,140 | 3.00 | 6.1 | 3,418 |
| August 11 | do | 380 | 960 | 2.78 | 5.5 | 2,673 |
| August 12 | do | 380 | 888 | 2.62 | 5.4 | 2,322 |
| August 19 | do | 380 | 524 | 1.65 | 3.9 | 866 |
| August 26 | do | 305 | 386 | 1.53 | 3.5 | 591 |

[a] Float measurement.

### *Daily gage height, in feet, of Brazos River at Waco, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.8 | 3.2 | 4.8 | 25.0 | 7.1 | 7.1 | 6.9 | 3.1 | 3.35 | 3.05 | 3.15 |
| 2 | 2.5 | 2.8 | 3.2 | 10.35 | 12.9 | 6.9 | 6.55 | 6.7 | 3.1 | 3.15 | 3.0 | 3.2 |
| 3 | 2.5 | 2.75 | 3.2 | 11.6 | 10.5 | 6.65 | 6.3 | 6.55 | 3.1 | 3.0 | 2.9 | 3.15 |
| 4 | 2.5 | 2.7 | 3.15 | 8.7 | 9.3 | 6.0 | 6.75 | 6.4 | 3.0 | 4.8 | 2.85 | 3.1 |
| 5 | 2.5 | 2.7 | 3.1 | 7.7 | 9.1 | 5.75 | 6.55 | 6.05 | 3.1 | 5.9 | 2.8 | 3.0 |
| 6 | 2.5 | 2.7 | 3.1 | 7.35 | 13.15 | 5.35 | 6.7 | 6.0 | 3.0 | 4.9 | 2.8 | 2.95 |
| 7 | 2.5 | 2.7 | 3.3 | 7.05 | 10.7 | 4.9 | 9.2 | 7.1 | 3.0 | 4.55 | 2.8 | 2.85 |
| 8 | 2.5 | 2.7 | 3.75 | 6.65 | 14.1 | 4.8 | 7.95 | 7.6 | 3.0 | 4.1 | 2.75 | 2.8 |
| 9 | 2.5 | 2.85 | 4.5 | 6.55 | 15.0 | 4.7 | 7.3 | 7.1 | 3.0 | 4.25 | 3.65 | 2.8 |
| 10 | 2.5 | 3.5 | 4.15 | 6.4 | 5.2 | 4.65 | 6.9 | 6.55 | 2.95 | 4.65 | 4.15 | 2.8 |
| 11 | 2.55 | 3.3 | 4.0 | 5.9 | 9.35 | 4.55 | 6.5 | 5.75 | 2.9 | 4.4 | 3.95 | 2.8 |
| 12 | 5.3 | 3.3 | 3.75 | 5.65 | 11.0 | 4.4 | 7.7 | 5.75 | 3.0 | 4.6 | 3.85 | 2.85 |
| 13 | 4.55 | 3.2 | 3.65 | 5.3 | 17.45 | 4.3 | 7.4 | 5.5 | 8.1 | 4.3 | 5.0 | 4.1 |
| 14 | 3.25 | 3.1 | 3.55 | 5.9 | 28.6 | 4.25 | 7.65 | 5.0 | 8.95 | 4.1 | 4.5 | 5.1 |
| 15 | 2.9 | 2.95 | 3.6 | 4.55 | 13.5 | 4.4 | 7.4 | 4.75 | 7.3 | 3.95 | 4.3 | 4.95 |
| 16 | 2.65 | 3.5 | 4.05 | 4.45 | 11.8 | 4.9 | 6.55 | 4.6 | 6.6 | 3.75 | 4.3 | 4.45 |
| 17 | 3.1 | 3.0 | 5.65 | 4.25 | 11.7 | 4.75 | 6.45 | 4.35 | 6.3 | 3.55 | 4.15 | 4.2 |
| 18 | 3.2 | 3.6 | 8.15 | 4.1 | 10.5 | 4.55 | 6.1 | 3.95 | 6.45 | 3.4 | 3.85 | 4.25 |
| 19 | 3.1 | 4.85 | 6.3 | 4.1 | 9.3 | 4.65 | 5.55 | 3.75 | 6.3 | 5.35 | 3.65 | 4.95 |
| 20 | 3.0 | 4.95 | 6.1 | 4.1 | 8.6 | 4.8 | 4.9 | 5.15 | 6.05 | 7.55 | 3.5 | 5.45 |
| 21 | 3.0 | 4.4 | 7.25 | 4.05 | 7.8 | 7.6 | 4.45 | 4.7 | 6.65 | 6.6 | 3.45 | 5.1 |
| 22 | 2.95 | 3.75 | 5.5 | 4.0 | 13.8 | 8.8 | 4.2 | 4.35 | 5.05 | 5.75 | 3.35 | 4.55 |
| 23 | 2.9 | 3.55 | 5.1 | 4.0 | 12.7 | 7.35 | 4.7 | 4.0 | 4.5 | 5.55 | 3.3 | 4.15 |
| 24 | 2.9 | 3.4 | 4.95 | 14.2 | 16.15 | 8.25 | 4.5 | 3.9 | 4.3 | 5.1 | 3.4 | 4.0 |
| 25 | 2.9 | 3.25 | 4.55 | 14.0 | 15.05 | 7.5 | 4.75 | 3.8 | 4.1 | 4.4 | 3.4 | 3.9 |
| 26 | 2.85 | 3.2 | 4.15 | 8.8 | 13.9 | 7.55 | 6.8 | 3.65 | 4.0 | 4.15 | 3.4 | 3.75 |
| 27 | 2.8 | 3.25 | 4.05 | 13.15 | 13.35 | 8.35 | 12.0 | 3.45 | 3.85 | 4.0 | 3.35 | 3.55 |
| 28 | 2.8 | 3.3 | 4.05 | 9.3 | 11.6 | 12.55 | 17.1 | 3.3 | 3.8 | 3.75 | 3.25 | 3.5 |
| 29 | 2.8 | ....... | 5.1 | 10.1 | 9.0 | 8.65 | 12.9 | 3.25 | 3.65 | 3.55 | 3.2 | 3.45 |
| 30 | 2.8 | ....... | 5.15 | 22.0 | 8.7 | 7.15 | 9.0 | 3.2 | 3.55 | 3.45 | 3.1 | 3.4 |
| 31 | 2.8 | ....... | 4.7 | ....... | 7.85 | ....... | 7.55 | 3.1 | ....... | 3.3 | ....... | 3.5 |

*Station rating table for Brazos River at Waco, Tex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 62 | 3.70 | 820 | 5.80 | 2,955 | 9.50 | 9,200 |
| 2.10 | 82 | 3.80 | 900 | 6.00 | 3,220 | 10.00 | 10,260 |
| 2.20 | 104 | 3.90 | 980 | 6.20 | 3,490 | 10.50 | 11,360 |
| 2.30 | 128 | 4.00 | 1,065 | 6.40 | 3,770 | 11.00 | 12,510 |
| 2.40 | 145 | 4.10 | 1,150 | 6.60 | 4,055 | 11.50 | 13,700 |
| 2.50 | 184 | 4.20 | 1,235 | 6.80 | 4,345 | 12.00 | 14,900 |
| 2.60 | 215 | 4.30 | 1,320 | 7.00 | 4,645 | 12.50 | 16,150 |
| 2.70 | 248 | 4.40 | 1,410 | 7.20 | 4,955 | 13.00 | 17,450 |
| 2.80 | 284 | 4.50 | 1,500 | 7.40 | 5,275 | 13.50 | 18,800 |
| 2.90 | 323 | 4.60 | 1,595 | 7.60 | 5,605 | 14.00 | 20,200 |
| 3.00 | 365 | 4.70 | 1,695 | 7.80 | 5,945 | 14.50 | 21,660 |
| 3.10 | 410 | 4.80 | 1,795 | 8.00 | 6,300 | 15.00 | 23,180 |
| 3.20 | 460 | 4.90 | 1,900 | 8.20 | 6,660 | 16.00 | 26,400 |
| 3.30 | 520 | 5.00 | 2,005 | 8.40 | 7,030 | 17.00 | 29,850 |
| 3.40 | 590 | 5.20 | 2,225 | 8.60 | 7,410 | 18.00 | 33,500 |
| 3.50 | 665 | 5.40 | 2,455 | 8.80 | 7,790 | | |
| 3.60 | 740 | 5.60 | 2,700 | 9.00 | 8,190 | | |

The above table is based on discharge measurements made during 1900 to 1905 and is well defined.

*Estimated monthly discharge of Brazos River at Waco, Tex., for 1905.*

[Drainage area, 30,750 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,340 | 184 | 388 | 23,860 | 0.013 | 0.015 |
| February | 1,952 | 248 | 585 | 32,490 | .019 | .020 |
| March | 6,570 | 410 | 1,642 | 101,000 | .053 | .061 |
| April | 50,400 | 1,065 | 7,347 | 437,200 | .239 | .267 |
| May | 85,500 | 2,225 | 18,280 | 1,124,000 | .594 | .685 |
| June | 16,280 | 1,277 | 3,898 | 231,900 | .127 | .142 |
| July | 30,210 | 1,235 | 5,771 | 354,800 | .188 | .217 |
| August | 5,605 | 410 | 2,276 | 139,900 | .074 | .085 |
| September | 8,090 | 323 | 1,906 | 113,400 | .062 | .069 |
| October | 5,522 | 365 | 1,561 | 95,980 | .051 | .059 |
| November | 2,005 | 266 | 718 | 42,720 | .023 | .026 |
| December | 2,515 | 284 | 931 | 57,240 | .030 | .035 |
| The year | 85,500 | 184 | 3,775 | 2,754,000 | .123 | 1.68 |

## BRAZOS RIVER AT RICHMOND, TEX.

This station was established January 1, 1903, by Thomas U. Taylor. It is located at the bridge of the Southern Pacific Railroad.

The channel is straight for 200 feet above and 900 feet below the station, and has a width of about 175 feet at low water, without piers, and about 500 feet at ordinary high water, broken by three piers. During very high floods the left bank overflows and the width of the stream is 900 feet. The bed of the stream is sandy except around the piers, where it is stony, and is slightly shifting. The current is obstructed somewhat by old piles. Above and at Waco the river rises rapidly, and when it gets above gage height 30 feet overflows the bottom lands below the town. When the floods spread out over the bottom lands, as they do from Waco to Richmond, the river stays up longer in its lower stretches than it does in the upper sections, as the bottoms and the lowlands serve as storage reservoirs for the backwater and are drained slowly as the river recedes. Above Waco the surface water rushes off into the stream more rapidly, and the river rises more suddenly and falls almost as suddenly. For this reason it is possible for the maximum discharge at Waco to be greater than it is at Richmond.

Discharge measurements are made from the bridge. The initial point for soundings is the east face of the pier under the west end of the middle span.

A standard chain gage is attached to the bridge; length of chain, 53.82 feet. During 1905 the gage was read once each day by J. E. Winston. Bench marks were established as follows: (1) The top of the tie at the downspout of the gage box in the central panel of the middle span on the downstream side of the bridge; elevation, 51.52 feet. (2) A point marked "R. F." on the southeast corner of the tie seat of west abutment; elevation, 51.11 feet. (3) The top of the north bolt in flange of hydrant at corner of Railroad and First streets, 6 inches below the top of the hydrant; elevation, 47.26 feet. (4) The top of the northeast corner of base stone of "Our Heroes" monument in the court-house square; elevation, 53.52 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 147; 99, p 329; 132, pp 32-33.
Discharge: 84, p 147; 99, p 330; 132, p 33.
Discharge, monthly: 99, p 332; 132, p 35.
Gage heights: 99, pp 330-331; 132, p 33.
Rating table: 99, p 331; 132, p 34.

*Discharge measurements of Brazos River at Richmond, Tex., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| July 25 | T. U. Taylor | 9.1 | 9,400 |
| August 4 | do | 8.4 | 7,960 |

*Daily gage height, in feet, of Brazos River at Richmond, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 6.1 | 5.6 | 10.1 | 28.1 | 18.1 | 19.5 | 13.6 | 3.4 | 8.1 | 3.4 | 3.1 |
| 2 | 3.2 | 6.0 | 5.4 | 9.9 | 28.2 | 18.1 | 19.1 | 10.3 | 3.3 | 3.0 | 3.2 | 3.0 |
| 3 | 4.1 | 5.8 | 4.8 | 9.2 | 28.3 | 15.1 | 18.9 | 9.3 | 3.4 | 3.0 | 3.3 | 3.0 |
| 4 | 2.9 | 5.6 | 3.6 | 15.9 | 30.2 | 14.0 | 17.4 | 8.4 | 3.4 | 4.9 | 3.2 | 3.1 |
| 5 | 2.7 | 5.1 | 6.0 | 18.1 | 31.9 | 13.8 | 17.1 | 7.8 | 3.6 | 2.5 | 3.2 | 3.2 |
| 6 | 2.6 | 6.1 | 9.7 | 17.1 | 33.0 | 13.6 | 15.6 | 7.8 | 3.0 | 2.5 | 3.3 | 3.2 |
| 7 | 2.3 | 5.9 | 10.1 | 15.0 | 32.9 | 13.5 | 15.2 | 6.2 | 2.6 | 2.5 | 3.4 | 3.3 |
| 8 | 2.6 | 6.0 | 9.5 | 13.2 | 32.2 | 11.8 | 14.8 | 6.3 | 2.6 | 2.5 | 3.6 | 3.3 |
| 9 | 3.1 | 6.1 | 8.8 | 12.0 | 31.2 | 11.5 | 14.5 | 6.35 | 2.6 | 2.6 | 3.7 | 3.5 |
| 10 | 3.1 | 6.0 | 11.9 | 11.7 | 32.1 | 11.0 | 14.3 | 6.5 | 2.6 | 2.8 | 3.8 | 3.3 |
| 11 | 3.1 | 6.1 | 11.4 | 11.1 | 31.1 | 11.0 | 14.3 | 6.7 | 2.6 | 3.2 | 4.0 | 3.2 |
| 12 | 3.1 | 5.6 | 10.9 | 10.9 | 31.0 | 9.9 | 14.2 | 7.0 | 2.6 | 3.4 | 4.1 | 3.3 |
| 13 | 3.1 | 6.1 | 10.6 | 10.8 | 31.3 | 8.6 | 14.1 | 7.1 | 4.3 | 3.2 | 4.2 | 3.3 |
| 14 | 3.1 | 6.4 | 9.6 | 10.6 | 31.5 | 9.1 | 14.0 | 6.0 | 4.8 | 3.2 | 4.2 | 3.4 |
| 15 | 3.1 | 6.3 | 7.7 | 10.1 | 31.5 | 8.6 | 14.0 | 5.1 | 5.7 | 3.2 | 4.3 | 3.5 |
| 16 | 3.1 | 8.0 | 10.1 | 9.1 | 31.8 | 8.4 | 13.8 | 5.2 | 6.2 | 3.2 | 4.3 | 3.7 |
| 17 | 3.6 | 10.6 | 8.3 | 8.1 | 32.1 | 8.2 | 13.0 | 5.4 | 6.5 | 3.2 | 4.5 | 4.6 |
| 18 | 5.4 | 10.8 | 11.1 | 8.0 | 32.1 | 8.2 | 11.3 | 5.1 | 6.7 | 3.2 | 4.5 | 6.3 |
| 19 | 3.9 | 9.8 | 16.1 | 7.8 | 31.6 | 8.2 | 11.1 | 4.9 | 7.0 | 3.2 | 4.3 | 8.0 |
| 20 | 3.8 | 10.1 | 17.1 | 5.0 | 31.65 | 8.3 | 10.8 | 4.7 | 6.3 | 3.1 | 4.2 | 8.4 |
| 21 | 3.5 | 9.1 | 17.1 | 2.8 | 28.6 | 8.2 | 9.7 | 4.0 | 4.3 | 3.1 | 4.0 | 8.4 |
| 22 | 3.0 | 9.3 | 15.4 | 2.5 | 28.6 | 8.4 | 9.2 | 4.0 | 4.4 | 4.2 | 3.8 | 8.7 |
| 23 | 2.8 | 10.1 | 13.9 | 2.1 | 29.0 | 9.9 | 9.1 | 4.0 | 4.6 | 5.7 | 3.5 | 8.8 |
| 24 | 3.0 | 7.8 | 14.9 | 2.2 | 27.8 | 11.8 | 9.1 | 4.0 | 5.3 | 6.3 | 3.6 | 8.0 |
| 25 | 3.0 | 7.1 | 13.3 | 20.1 | 25.7 | 11.8 | 9.1 | 4.0 | 5.3 | 7.1 | 3.4 | 7.1 |
| 26 | 5.1 | 5.9 | 12.8 | 20.6 | 25.5 | 12.1 | 6.5 | 4.0 | 4.2 | 6.3 | 3.4 | 7.3 |
| 27 | 6.1 | 5.0 | 10.8 | 21.7 | 25.0 | 22.0 | 8.0 | 3.9 | 4.4 | 5.3 | 3.3 | 7.5 |
| 28 | 6.1 | 5.1 | 9.1 | 23.6 | 24.7 | 20.8 | 11.4 | 3.9 | 4.2 | 4.8 | 3.3 | 7.3 |
| 29 | 6.0 | ....... | 10.7 | 23.5 | 20.9 | 20.3 | 13.7 | 3.8 | 4.2 | 4.5 | 3.3 | 7.1 |
| 30 | 5.9 | ....... | 13.4 | 25.1 | 18.3 | 19.9 | 14.3 | 3.6 | 3.4 | 4.3 | 3.1 | 6.1 |
| 31 | 6.1 | ....... | 11.7 | ....... | 18.1 | ....... | 14.4 | 3.4 | ....... | 4.0 | ....... | 6.4 |

*Station rating table for Brazos River at Richmond, Tex., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 820 | 3.00 | 1,820 | 4.50 | 3,310 | 7.00 | 6,500 |
| 1.60 | 870 | 3.10 | 1,910 | 4.60 | 3,420 | 7.20 | 6,780 |
| 1.70 | 920 | 3.20 | 2,000 | 4.70 | 3,530 | 7.40 | 7,060 |
| 1.80 | 980 | 3.30 | 2,090 | 4.80 | 3,640 | 7.60 | 7,350 |
| 1.90 | 1,040 | 3.40 | 2,180 | 4.90 | 3,760 | 7.80 | 7,650 |
| 2.00 | 1,100 | 3.50 | 2,270 | 5.00 | 3,880 | 8.00 | 7,950 |
| 2.10 | 1,160 | 3.60 | 2,370 | 5.20 | 4,120 | 8.50 | 8,700 |
| 2.20 | 1,220 | 3.70 | 2,470 | 5.40 | 4,360 | 9.00 | 9,480 |
| 2.30 | 1,290 | 3.80 | 2,570 | 5.60 | 4,600 | 9.50 | 10,280 |
| 2.40 | 1,360 | 3.90 | 2,670 | 5.80 | 4,860 | 10.00 | 11,120 |
| 2.50 | 1,430 | 4.00 | 2,770 | 6.00 | 5,120 | 10.50 | 12,020 |
| 2.60 | 1,500 | 4.10 | 2,870 | 6.20 | 5,380 | 11.00 | 13,020 |
| 2.70 | 1,580 | 4.20 | 2,980 | 6.40 | 5,660 | 11.50 | 14,120 |
| 2.80 | 1,660 | 4.30 | 3,090 | 6.60 | 5,940 | 12.00 | 15,270 |
| 2.90 | 1,740 | 4.40 | 3,200 | 6.80 | 6,220 | 13.00 | 17,590 |

The above table is based on discharge measurements made during 1902-1905, and it is well defined. Above gage height 13 feet the rating curve is a tangent, the difference being 240 per tenth. Above 10 feet this table is the same as the 1903 table.

*Estimated monthly discharge of Brazos River at Richmond, Tex., for 1905.*

[Drainage area, 44,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 5,250 | 1,290 | 2,594 | 159,500 | 0.059 | 0.068 |
| February | 12,620 | 3,880 | 6,742 | 374,400 | .153 | .159 |
| March | 27,430 | 2,370 | 13,380 | 822,700 | .304 | .350 |
| April | 46,630 | 1,160 | 17,680 | 1,052,000 | .402 | .448 |
| May | 65,590 | 29,830 | 55,690 | 3,424,000 | 1.27 | 1.46 |
| June | 39,190 | 8,250 | 17,070 | 1,016,000 | .388 | .433 |
| July | 33,190 | 5,800 | 18,680 | 1,149,000 | .425 | .490 |
| August | 19,030 | 2,180 | 5,290 | 325,300 | .120 | .138 |
| September | 6,500 | 1,500 | 3,169 | 188,600 | .072 | .080 |
| October | 6,640 | 1,430 | 2,665 | 163,900 | .061 | .070 |
| November | 3,310 | 1,910 | 2,498 | 148,600 | .057 | .064 |
| December | 9,160 | 1,820 | 4,465 | 274,500 | .101 | .116 |
| The year | 65,590 | 1,160 | 12,490 | 9,098,000 | .284 | 3.88 |

## COLORADO RIVER (OF TEXAS) DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Colorado River rises in the extreme western portion of the State, within a few miles of the eastern boundary of New Mexico, and flows in a general southeasterly direction, emptying into the Gulf of Mexico in Matagorda County. The drainage area above Austin is 37,000 square miles and above Columbus 40,000 square miles, and it extends into the corner of New Mexico. Its main tributaries are the Concho, the San Saba, and the Llano. The Concho has a reliable flow and contributes a greater amount of water than the Colorado at their junction. The Concho furnishes water for irrigation and water power and supports in Irion and Tom Green counties some excellent irrigation systems, described in Water-Supply Paper No. 71. San Saba and Llano rivers are described in the same paper.

The Colorado at Austin emerges from a canyon. From Austin to the Gulf it traverses a rather flat country, and its waters are utilized for many power plants; 60,000 acres of rice were sowed during the season of 1902 in the counties of Colorado, Wharton, and Matagorda, under canals that obtained their water from the Colorado.

### COLORADO RIVER AT AUSTIN, TEX.

This station was established December 21, 1897. It was originally located at the dam near Austin, Tex. On the failure of this dam the station was removed to the Congress Avenue Bridge, south of the city.

The channel is straight for 400 feet above and below the station. The velocity is moderately rapid. Neither bank has overflowed since the dam was washed away. The bed of the stream is composed of sand and is slightly shifting.

Discharge measurements are made by means of a cable and car 3 miles above Congress Avenue Bridge, about one-eighth mile above the ruins of the Austin dam and power house. The cable has a span of about 730 feet, but the width of the river at low water is less than half this distance.

Gage heights were first taken on the crest of the Austin dam August 13, 1895, and were continued from that date until the failure of the dam occurred in April, 1900. A staff gage consisting of upright posts driven into the bank of the river is located near the bath house about 150 feet above the bridge. For higher gage heights the first pier from the north has been marked up to 40.00 feet. A standard chain gage is attached to the bridge at the same datum. During 1905 the gage was read twice each day by W. Peterson. Bench marks were established as follows: (1) A United States Coast and Geodetic Survey copper bolt on the top of the west end of the south pier of Congress Avenue Bridge, 475 feet above mean sea level and 48.00 feet above the datum of the gage. (2) A similar bolt in the southwest wall of the post-office at Austin, 508 feet above mean sea level; elevation, 81.00 feet above the datum of the gage. (3) On the first flange above the cribwork of the north pier of the bridge, marked "U. S. G. S. B. M. 4.78"; elevation, 4.78 feet above gage datum and 431.78 feet above mean sea level.

The low-water level at this point has been gradually falling for over a year. This has been caused by the erosion of the channel about 200 yards below the highway bridge. Under the highway bridge the water spreads out into a large pool, the outlet of which is through two contracted sections below, the main one of which being the one in which the erosion has taken place. The lowest level that the water has reached yet has been 0.70 foot by gage, but the corresponding discharge was no less than the minimum of 1902.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, pp 82-83; WS 28, pp 118-119; 37, p 274; 50, pp 336-337; 66, p 64; 84, pp 149-150; 99, p 334; 132, p 36.

Discharge: Ann 18, iv, p 110; Bull 140, p 83; WS 28, p 129; 37, p 274; 50, p 337; 66, p 64; 84, p 150; 99, p 335; 132, p 37.

Discharge, monthly: WS 75, p 152; 84, p 152; 99, p 336; 132, p 39.

Gage heights: WS 28, pp 122-124; 37, p 275; 50, p 338; 66, p 64; 84, p 151; 99, p 335; 132, p 38.

Hydrograph: WS 75, p 152.

Rating tables: WS 66, p 173; 84, p 151; 99, p 336; 132, p 39.

*Discharge measurements of Colorado River at Austin, Tex., in 1905.*

| Date. | Hydographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Second-feet.* |
| July 15 | H. H. Fox | 2.7 | 1,760 |
| July 17 | do | 2.2 | 1,111 |
| July 21 | do | 1.7 | 520 |
| August 19 | do | 1.1 | 240 |
| September 3 | do | .8 | 176 |
| September 16 | T. U. Taylor | .8 | 171 |

*Daily gage height, in feet, of Colorado River at Austin, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 1.2 | 1.3 | 1.8 | 7.9 | 2.75 | 2.25 | 4.2 | 0.8 | 1.25 | 1.0 | 1.0 |
| 2 | 1.25 | 1.2 | 1.3 | 1.85 | 6.75 | 3.7 | 2.05 | 3.2 | .85 | 1.15 | 1.1 | 1.0 |
| 3 | 1.2 | 1.2 | 1.25 | 2.95 | 5.35 | 3.15 | 1.85 | 2.75 | .8 | 1.1 | 1.1 | 1.0 |
| 4 | 1.2 | 1.2 | 1.2 | 5.5 | 4.55 | 2.9 | 2.0 | 2.6 | .8 | 1.0 | 1.1 | 1.0 |
| 5 | 1.2 | 1.2 | 1.2 | 4.8 | 4.2 | 2.65 | 1.8 | 2.45 | 1.0 | 1.0 | 1.1 | 1.0 |
| 6 | 1.2 | 1.2 | 1.2 | 3.5 | 3.85 | 2.5 | 1.7 | 2.4 | 1.25 | 1.0 | .95 | 1.0 |
| 7 | 1.2 | 1.2 | 1.25 | 5.1 | 3.55 | 2.5 | 2.6 | 2.3 | 1.0 | 1.3 | 1.0 | 1.0 |
| 8 | 1.2 | 1.2 | 1.65 | 3.75 | 3.35 | 2.35 | 3.3 | 2.15 | .9 | 2.15 | 1.0 | 1.0 |
| 9 | 1.2 | 1.2 | 1.6 | 3.05 | 10.5 | 2.2 | 4.0 | 1.85 | .8 | 2.95 | 1.25 | 1.0 |
| 10 | 1.2 | 1.2 | 1.5 | 2.75 | 7.85 | 2.1 | 4.65 | 1.55 | .8 | 2.45 | 1.85 | 1.0 |
| 11 | 1.2 | 1.2 | 1.5 | 2.55 | 6.6 | 2.0 | 3.95 | 1.9 | .85 | 2.2 | 2.4 | 1.0 |
| 12 | 1.2 | 1.2 | 1.6 | 2.5 | 4.95 | 1.9 | 3.6 | 1.8 | .95 | 2.05 | 2.9 | 1.0 |
| 13 | 1.2 | 1.6 | 1.65 | 2.4 | 3.9 | 1.8 | 3.25 | 1.65 | .9 | 1.95 | 2.7 | 1.25 |
| 14 | 1.3 | 1.15 | 1.6 | 2.4 | 3.6 | 1.8 | 3.05 | 1.5 | .8 | 1.75 | 2.25 | 1.15 |
| 15 | 1.3 | 1.25 | 1.6 | 2.3 | 4.75 | 1.8 | 2.7 | 1.35 | .8 | 1.55 | 1.95 | 1.0 |
| 16 | 1.25 | 1.15 | 1.75 | 2.15 | 7.6 | 2.2 | 2.4 | 1.3 | .8 | 1.45 | 1.75 | 1.0 |
| 17 | 1.2 | 1.2 | 2.95 | 2.0 | 8.1 | 2.3 | 2.2 | 1.2 | 1.7 | 1.3 | 1.65 | 1.0 |
| 18 | 1.2 | 1.25 | 3.3 | 2.0 | 5.6 | 2.25 | 2.05 | 1.2 | 2.5 | 1.3 | 1.4 | 1.1 |
| 19 | 1.25 | 1.3 | 5.7 | 1.85 | 3.9 | 1.9 | 1.9 | 1.15 | 2.2 | 1.2 | 1.3 | 1.35 |
| 20 | 1.2 | 1.3 | 3.75 | 1.8 | 3.25 | 1.8 | 1.8 | 1.05 | 2.05 | 1.3 | 1.2 | 1.5 |
| 21 | 1.2 | 1.3 | 3.55 | 1.8 | 3.0 | 1.7 | 1.7 | 1.0 | 2.4 | 2.2 | 1.2 | 1.6 |
| 22 | 1.2 | 1.4 | 3.55 | 1.8 | 2.85 | 1.75 | 1.65 | 1.0 | 2.15 | 3.35 | 1.1 | 1.5 |
| 23 | 1.2 | 1.5 | 3.0 | 1.7 | 2.6 | 2.0 | 1.55 | 1.0 | 1.9 | 2.55 | 1.1 | 1.4 |
| 24 | 1.2 | 1.5 | 2.6 | 4.25 | 2.55 | 1.9 | 1.45 | .9 | 1.8 | 2.05 | 1.1 | 1.6 |
| 25 | 1.2 | 1.4 | 2.5 | 9.2 | 4.75 | 3.2 | 1.4 | .9 | 1.9 | 1.7 | 1.1 | 1.6 |
| 26 | 1.2 | 1.4 | 2.4 | 7.3 | 4.55 | 3.15 | 1.4 | .82 | 1.8 | 1.45 | 1.1 | 1.4 |
| 27 | 1.2 | 1.4 | 2.25 | 6.25 | 4.45 | 2.85 | 1.3 | .8 | 1.7 | 1.3 | 1.1 | 1.2 |
| 28 | 1.15 | 1.3 | 2.15 | 5.75 | 3.7 | 2.7 | 1.3 | .8 | 1.57 | 1.25 | 1.1 | 1.15 |
| 29 | 1.1 | ....... | 2.05 | 7.65 | 3.5 | 2.7 | 1.8 | .9 | 1.5 | 1.2 | 1.05 | 1.0 |
| 30 | 1.1 | ....... | 1.9 | 15.05 | 3.9 | 2.5 | 3.6 | .9 | 1.4 | 1.2 | 1.0 | 1.3 |
| 31 | 1.1 | ....... | 1.9 | ....... | 3.35 | ....... | 5.95 | .9 | ....... | 1.15 | ....... | 1.2 |

*Station rating table for Colorado River at Austin, Tex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 175 | 1.90 | 790 | 3.00 | 2,260 | 4.20 | 5,170 |
| .90 | 195 | 2.00 | 885 | 3.10 | 2,450 | 4.40 | 5,810 |
| 1.00 | 220 | 2.10 | 990 | 3.20 | 2,650 | 4.60 | 6,510 |
| 1.10 | 250 | 2.20 | 1,105 | 3.30 | 2,860 | 4.80 | 7,270 |
| 1.20 | 290 | 2.30 | 1,225 | 3.40 | 3,070 | 5.00 | 8,080 |
| 1.30 | 340 | 2.40 | 1,345 | 3.50 | 3,290 | 5.20 | 8,920 |
| 1.40 | 400 | 2.50 | 1,470 | 3.60 | 3,530 | 5.40 | 9,760 |
| 1.50 | 470 | 2.60 | 1,605 | 3.70 | 3,780 | 5.60 | 10,600 |
| 1.60 | 540 | 2.70 | 1,750 | 3.80 | 4,040 | 5.80 | 11,440 |
| 1.70 | 620 | 2.80 | 1,910 | 3.90 | 4,310 | 6.00 | 12,280 |
| 1.80 | 700 | 2.90 | 2,080 | 4.00 | 4,580 | 6.20 | 13,130 |

The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 0.8 foot and 6 feet. Above gage height 6.1 feet the rating curve is a tangent, the difference being 430 per tenth.

*Estimated monthly discharge of Colorado River at Austin, Tex., for 1905.*

[Drainage area, 37,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 340 | 250 | 293 | 18,020 | 0.0079 | 0.0091 |
| February | 540 | 270 | 335 | 18,600 | .0091 | .0095 |
| March | 11,020 | 290 | 1,461 | 89,830 | .039 | .045 |
| April | 51,190 | 620 | 6,557 | 390,200 | .177 | .198 |
| May | 31,620 | 1,537 | 8,267 | 508,300 | .223 | .257 |
| June | 3,780 | 620 | 1,404 | 83,540 | .038 | .042 |
| July | 12,070 | 340 | 1,949 | 119,800 | .053 | .061 |
| August | 5,170 | 175 | 775 | 47,650 | .021 | .024 |
| September | 1,470 | 175 | 488 | 29,040 | .013 | .014 |
| October | 2,965 | 220 | 689 | 42,360 | .019 | .022 |
| November | 2,080 | 207 | 505 | 30,050 | .014 | .016 |
| December | 540 | 220 | 299 | 18,380 | .0081 | .0093 |
| The year | 51,190 | 175 | 1,918 | 1,396,000 | .052 | .707 |

## COLORADO RIVER AT COLUMBUS, TEX.

This station was established in December, 1902, by Thomas U. Taylor. It is located at the highway bridge east of Columbus.

The channel is straight for 200 feet above and 600 feet below the bridge, and has a width of 140 feet at low water, unobstructed by piers, and a width of 450 feet at ordinary high water, broken by two piers. At very high stages the left bank overflows for several hundred feet, but the water passes under the iron trestle approach to the bridge. The bed is composed of gravel and sand and is fairly permanent.

Discharge measurements are made from the three-span highway bridge at which the gage is located.

A gage is marked on the downstream side of the pier on the west side of the river. Gage datum is taken at 50 feet below the top of this pier, and the observer, W. E. Bridge, measures down from this point with a tagged chain and lead weight. Bench marks were established as follows: (1) The top of pier at the west end of the middle span of the bridge; elevation, 50.00 feet. (2) The east end of the top of the top stone step at the south door of the Columbus jail; elevation, 53.22 feet. (3) The north end of the top stone step at the east door of the Columbus court-house; elevation, 53.91 feet. (4) The top of the rail over the extreme west pier of the Southern Railway bridge crossing the river above the gaging station; elevation, 51.13 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 5, 1905, by T. U. Taylor gave the following results: Gage height, 10.8 feet; discharge, 3,820 second-feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 149; 99, pp 332–333; 132, p 40.
Discharge: 84, p 149; 99, p 333; 132, p 40.
Discharge, monthly: 132, p 42.
Gage heights: 99, pp 333–334; 132, p 41.
Rating table: 132, p 42.

*Daily gage height, in feet, of Colorado River at Columbus, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.45 | 5.8 | 6.4 | 7.9 | 30.75 | 12.25 | 10.5 | 7.5 | 6.8 | 7.3 | 7.7 | 7.0 |
| 2 | 6.4 | 5.8 | 6.3 | 8.9 | 33.0 | 12.1 | 10.05 | 14.15 | 6.8 | 7.2 | 7.7 | 6.9 |
| 3 | 6.4 | 6.0 | 6.2 | 14.1 | 30.7 | 11.3 | 9.6 | 13.5 | 7.2 | 7.15 | 6.9 | 6.75 |
| 4 | 6.4 | 6.0 | 6.2 | 11.4 | 21.15 | 11.15 | 10.05 | 11.85 | 7.1 | 7.1 | 6.9 | 6.7 |
| 5 | 6.2 | 5.8 | 6.0 | 9.1 | 17.4 | 11.85 | 10.25 | 10.6 | 6.9 | 7.05 | 6.9 | 6.7 |
| 6 | 6.2 | 5.8 | 6.0 | 13.55 | 15.6 | 11.05 | 9.65 | 9.75 | 6.8 | 7.0 | 6.9 | 6.6 |
| 7 | 6.2 | 5.8 | 6.0 | 13.2 | 14.3 | 10.4 | 8.9 | 9.05 | 6.8 | 6.9 | 7.15 | 6.5 |
| 8 | 6.2 | 5.8 | 10.5 | 11.95 | 13.25 | 9.9 | 8.55 | 8.55 | 6.8 | 6.9 | 7.0 | 6.5 |
| 9 | 6.0 | 6.0 | 12.45 | 14.0 | 12.6 | 9.6 | 11.75 | 8.35 | 6.8 | 6.75 | 8.5 | 6.5 |
| 10 | 6.0 | 6.1 | 11.4 | 12.35 | 16.6 | 9.55 | 14.8 | 8.5 | 6.9 | 6.7 | 9.05 | 6.6 |
| 11 | 6.0 | 6.2 | 9.55 | 11.0 | 24.5 | 9.4 | 15.0 | 8.5 | 6.9 | 6.6 | 8.4 | 6.6 |
| 12 | 6.0 | 6.2 | 8.4 | 10.25 | 21.75 | 9.1 | 14.0 | 8.2 | 6.8 | 9.05 | 7.8 | 6.6 |
| 13 | 6.0 | 6.4 | 7.85 | 9.7 | 17.95 | 8.65 | 12.85 | 8.1 | 6.7 | 8.7 | 7.5 | 7.8 |
| 14 | 7.2 | 6.4 | 7.35 | 8.7 | 16.8 | 8.65 | 12.2 | 8.1 | 6.65 | 8.15 | 8.0 | 7.6 |
| 15 | 7.05 | 6.2 | 9.5 | 9.05 | 21.1 | 8.5 | 11.3 | 8.0 | 6.6 | 8.05 | 8.0 | 7.25 |
| 16 | 6.4 | 6.2 | 14.45 | 8.75 | 18.25 | 8.5 | 10.95 | 7.75 | 6.6 | 7.7 | 8.45 | 7.1 |
| 17 | 6.4 | 6.0 | 10.1 | 8.65 | 17.0 | 8.45 | 10.4 | 7.55 | 6.6 | 7.6 | 8.35 | 7.1 |
| 18 | 6.2 | 5.9 | 13.9 | 8.5 | 22.75 | 8.95 | 9.7 | 7.5 | 6.6 | 7.6 | 7.9 | 7.0 |
| 19 | 6.2 | 15.5 | 18.5 | 8.35 | 20.2 | 9.35 | 9.2 | 7.5 | 6.6 | 7.3 | 7.6 | 8.2 |
| 20 | 6.2 | 12.0 | 16.0 | 8.1 | 16.05 | 9.25 | 8.6 | 7.25 | 6.6 | 7.3 | 7.45 | 8.4 |
| 21 | 6.0 | 9.75 | 15.6 | 8.0 | 13.8 | 8.9 | 8.6 | 7.4 | 7.25 | 7.2 | 7.4 | 8.1 |
| 22 | 6.0 | 8.25 | 18.75 | 7.85 | 12.1 | 9.5 | 8.5 | 7.2 | 8.1 | 7.2 | 7.35 | 7.6 |
| 23 | 6.1 | 7.5 | 14.9 | 7.7 | 11.8 | 11.75 | 8.3 | 7.05 | 8.05 | 7.15 | 7.2 | 7.3 |
| 24 | 6.1 | 6.85 | 16.6 | 22.25 | 14.75 | 9.4 | 8.15 | 7.0 | 8.15 | 7.45 | 7.1 | 7.2 |
| 25 | 6.0 | 6.65 | 11.05 | 24.45 | 13.25 | 8.5 | 8.1 | 6.95 | 8.35 | 9.85 | 7.1 | 8.0 |
| 26 | 6.0 | 6.55 | 10.25 | 24.25 | 12.3 | 10.8 | 8.05 | 6.9 | 7.9 | 9.2 | 7.15 | 7.5 |
| 27 | 5.95 | 6.4 | 9.65 | 21.65 | 12.35 | 24.75 | 8.0 | 6.95 | 7.65 | 7.9 | 7.45 | 7.3 |
| 28 | 5.85 | 6.4 | 9.15 | 19.0 | 14.25 | 17.0 | 8.0 | 6.85 | 7.45 | 7.7 | 7.1 | 6.95 |
| 29 | 5.8 | ....... | 11.4 | 18.35 | 13.6 | 13.25 | 7.7 | 6.8 | 7.5 | 7.5 | 7.1 | 6.9 |
| 30 | 5.85 | ....... | 9.2 | 26.25 | 12.7 | 11.5 | 7.6 | 6.8 | 7.5 | 7.3 | 7.0 | 7.0 |
| 31 | 5.8 | ....... | 8.25 | ....... | 12.45 | ....... | 7.6 | 6.8 | ....... | 7.2 | ....... | 7.0 |

*Station rating table for Colorado River at Columbus, Tex., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.40 | 510 | 7.30 | 1.460 | 9.40 | 2,850 | 13.50 | 6,160 |
| 5.50 | 550 | 7.40 | 1,520 | 9.60 | 2,990 | 14.00 | 6,610 |
| 5.60 | 590 | 7.50 | 1,580 | 9.80 | 3,130 | 14.50 | 7,090 |
| 5.70 | 630 | 7.60 | 1,640 | 10.00 | 3,270 | 15.00 | 7,590 |
| 5.80 | 680 | 7.70 | 1,700 | 10.20 | 3,410 | 16.00 | 8,660 |
| 5.90 | 730 | 7.80 | 1,760 | 10.40 | 3,570 | 17.00 | 9,860 |
| 6.00 | 780 | 7.90 | 1,820 | 10.60 | 3,730 | 18.00 | 11,140 |
| 6.10 | 830 | 8.00 | 1,880 | 10.80 | 3,890 | 19.00 | 12,520 |
| 6.20 | 880 | 8.10 | 1,940 | 11.00 | 4,050 | 20.00 | 13,970 |
| 6.30 | 930 | 8.20 | 2,010 | 11.20 | 4,210 | 21.00 | 15,470 |
| 6.40 | 980 | 8.30 | 2,080 | 11.40 | 4,370 | 22.00 | 17,030 |
| 6.50 | 1,030 | 8.40 | 2,150 | 11.60 | 4,530 | 23.00 | 18,700 |
| 6.60 | 1,080 | 8.50 | 2,220 | 11.80 | 4,690 | 24.00 | 20,420 |
| 6.70 | 1,130 | 8.60 | 2,290 | 12.00 | 4,850 | 25.00 | 22,200 |
| 6.80 | 1,180 | 8.70 | 2.360 | 12.20 | 5,010 | 26.00 | 24,070 |
| 6.90 | 1,230 | 8.80 | 2,430 | 12.40 | 5,170 | 27.00 | 25.980 |
| 7.00 | 1,280 | 8.90 | 2,500 | 12.60 | 5,350 | 28.00 | 27,920 |
| 7.10 | 1,340 | 9.00 | 2,570 | 12.80 | 5,530 | | |
| 7.20 | 1,400 | 9.20 | 2,710 | 13.00 | 5,710 | | |

The above table is based on discharge measurements made during 1902–1905. It is well defined.

*Estimated monthly discharge of Colorado River at Columbus, Tex., for 1905.*

[Drainage area, 40,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,400 | 680 | 895 | 55,030 | 0.022 | 0.025 |
| February | 8,110 | 680 | 1,044 | 57,980 | .026 | .027 |
| March | 12,180 | 780 | 4,115 | 253,000 | .103 | .119 |
| April | 24,550 | 1,700 | 6,775 | 403,100 | .169 | .189 |
| May | 37,900 | 4,690 | 11,830 | 727,400 | .296 | .341 |
| June | 21,750 | 2,185 | 4,194 | 249,600 | .105 | .117 |
| July | 7,590 | 1,640 | 3,303 | 203,100 | .083 | .096 |
| August | 6,745 | 1,180 | 2,166 | 133,200 | .054 | .062 |
| September | 2,115 | 1,080 | 1,366 | 81,290 | .034 | .038 |
| October | 3,165 | 1,080 | 1,622 | 99,730 | .041 | .047 |
| November | 2,605 | 1,230 | 1,611 | 95,860 | .040 | .045 |
| December | 2,150 | 1,030 | 1,377 | 84,670 | .034 | .039 |
| The year | 37,900 | 680 | 3,358 | 2,444,000 | .084 | 1.14 |

## SAN SABA RIVER NEAR SAN SABA, TEX.

San Saba River rises in two springs near Fort McKavett, in the western part of Menard County, Tex., and flows in an easterly direction for over 100 miles to its junction with Colorado River (of Texas). It is fed by many springs between Fort McKavett and Menardville, the largest of which is the one that feeds or is the source of Clear Creek.

A gaging station was established on San Saba River at the suspension bridge, 1 mile northwest of the town of San Saba, Tex., December 30, 1904, by E. C. H. Bantel. The drainage area above the town of San Saba is 3,000 square miles.

Sixteen miles above the gaging station the river issues from the canyon section of the river and emerges into a very rich valley that offers exceptional advantages for irrigation. There are about 40,000 acres that could be brought under a supplemental irrigation system, and the water supply of the San Saba River at this point becomes of the utmost importance. The low-water flow at the "Narrows," 17 miles above the town of San Saba, is about 25 second-feet, and any irrigation on an extensive scale will have to be done by means of an impounding dam, which can be constructed across the river near the ranch of Hilliard Doran, forming the reservoir in the canyon section of the river. Four miles above the town of Menardville the Noyes ditch takes out the larger supply of water from the river and diverts it into an irrigation system that extends through Menardville and to a point 5 miles below. Two other smaller ditches below San Saba, the Maimee and the Kitchen, divert practically all the remainder of the low flow into irrigation systems. In addition to the gravity systems there are several pumping plants along the stream from Fort McKavett to the head of the canyons, about 12 miles below Menardville. Thus in dry times about the only water that could be relied on for a big irrigation system in the San Saba Valley would be the water that could be stored by an impounding reservoir. The topography, the flood discharges, the excellent site for a dam, the nearness of stone, the absence of alkali in the water, and the richness of the soil all point to the fact that this valley offers one of the best and most feasible irrigation problems in the State of Texas.

The channel is straight for 150 feet above and 1,000 feet below the station. The current is swift at high and sluggish at low stages. Both banks are high, but liable to overflow at high stages. The bed of the stream is composed of sand and gravel. There is but one channel at all stages.

Discharge measurements are made from the suspension bridge. The initial point for soundings is the north face of the south pier.

The elevations of the water surface are determined by measuring down by means of a tape from a certain casting on the upstream face in the flooring of the bridge, the zero elevation being 40.00 feet below the same. Bench marks were established as follows: (1) A large wire nail driven into a tree 50 feet from the south end of the bridge; elevation, 37.63 feet. (2) A wire nail driven into a water elm 70 feet from the north end of the bridge, on the east side of the road; elevation, 37.16 feet. (3) A wire nail driven into a live oak tree 200 feet from the south end of the bridge and 50 feet from the edge of the stream; elevation, 37.16 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 18, 1905, by T. U. Taylor, gave the following results: Gage height, 7.2 feet; discharge, 27 second-feet.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132, United States Geological Survey, pp. 43-44.

*Daily gage height, in feet, of San Saba River near San Saba, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.9 | 7.9 | 7.9 | 7.8 | 9.8 | 7.8 | 7.4 | 7.3 | 7.2 | 7.2 | 7.6 | 7.7 |
| 2 | 7.9 | 7.9 | 7.9 | 9.4 | 8.3 | 7.8 | 7.4 | 7.2 | 7.2 | 7.2 | 7.6 | 7.7 |
| 3 | 7.9 | 7.8 | 7.9 | 8.4 | 8.1 | 7.7 | 7.4 | 8.1 | 7.5 | 7.2 | 7.6 | 7.7 |
| 4 | 7.9 | 7.8 | 7.8 | 8.2 | 8.1 | 7.7 | 7.3 | 7.6 | 7.3 | 7.2 | 7.6 | 7.5 |
| 5 | 7.9 | 7.8 | 7.8 | 8.0 | 8.4 | 7.6 | 7.3 | 7.4 | 7.2 | 7.2 | 7.6 | 7.5 |
| 6 | 7.9 | 7.8 | 7.8 | 8.0 | 8.0 | 7.6 | 8.2 | 7.4 | 7.2 | 7.2 | 7.6 | 7.5 |
| 7 | 7.9 | 7.8 | 7.8 | 7.9 | 7.8 | 7.6 | 8.4 | 7.4 | 7.2 | 7.7 | 7.7 | 7.5 |
| 8 | 7.9 | 8.0 | 7.8 | 7.8 | 13.7 | 7.5 | 8.1 | 7.3 | 7.2 | 7.6 | 7.7 | 7.6 |
| 9 | 7.9 | 7.9 | 7.8 | 7.8 | 11.15 | 7.5 | 9.7 | 7.3 | 7.2 | 7.6 | 7.7 | 7.6 |
| 10 | 7.9 | 7.9 | 7.8 | 7.8 | 8.9 | 7.5 | 8.2 | 7.2 | 7.2 | 7.6 | 7.9 | 7.6 |
| 11 | 7.9 | 7.8 | 7.9 | 7.8 | 8.2 | 7.5 | 8.0 | 7.2 | 7.2 | 7.6 | 7.8 | 7.6 |
| 12 | 7.8 | 7.8 | 7.7 | 7.8 | 8.0 | 7.4 | 7.8 | 7.3 | 7.2 | 7.6 | 7.7 | 7.6 |
| 13 | 7.9 | 7.9 | 7.7 | 7.8 | 8.0 | 8.0 | 7.7 | 7.3 | 7.2 | 7.6 | 7.6 | 7.7 |
| 14 | 7.8 | 7.8 | 7.8 | 7.8 | 7.9 | 7.6 | 7.6 | 7.3 | 7.2 | 7.6 | 7.6 | 7.7 |
| 15 | 7.8 | 8.0 | 7.8 | 7.8 | 7.8 | 7.6 | 7.5 | 7.3 | 7.2 | 7.6 | 7.6 | 7.7 |
| 16 | 7.9 | 7.9 | 8.3 | 7.8 | 7.9 | 7.5 | 7.5 | 7.3 | 7.2 | 7.6 | 7.6 | 7.7 |
| 17 | 7.9 | 7.9 | 8.0 | 7.8 | 8.05 | 7.4 | 7.5 | 7.2 | 7.2 | 7.4 | 7.6 | 7.7 |
| 18 | 7.9 | 7.9 | 7.9 | 7.7 | 8.0 | 7.4 | 7.5 | 7.2 | 7.2 | 7.4 | 7.6 | 7.8 |
| 19 | 7.9 | 10.0 | 8.1 | 7.6 | 7.9 | 7.4 | 7.5 | 7.2 | 7.3 | 19.6 | 7.6 | 7.8 |
| 20 | 7.9 | 10.9 | 7.9 | 7.6 | 7.9 | 7.4 | 7.5 | 7.2 | 7.4 | 8.2 | 7.6 | 7.9 |
| 21 | 7.9 | 8.9 | 7.9 | 7.6 | 7.9 | 7.4 | 7.6 | 7.2 | 7.3 | 7.7 | 7.6 | 7.8 |
| 22 | 7.9 | 7.9 | 7.9 | 7.6 | 7.9 | 7.4 | 7.6 | 7.2 | 7.2 | 7.8 | 7.6 | 7.8 |
| 23 | 7.9 | 8.0 | 7.8 | 7.8 | 7.8 | 7.5 | 7.6 | 7.2 | 7.2 | 7.7 | 7.6 | 7.8 |
| 24 | 7.9 | 7.9 | 7.8 | 9.4 | 13.4 | 7.5 | 7.5 | 7.2 | 7.2 | 7.7 | 7.7 | 7.8 |
| 25 | 7.9 | 7.9 | 7.8 | 8.4 | 9.2 | 7.4 | 7.5 | 7.2 | 7.2 | 7.7 | 7.7 | 7.7 |
| 26 | 7.9 | 7.9 | 7.9 | 8.1 | 8.25 | 7.5 | 7.4 | 7.2 | 7.2 | 7.7 | 7.7 | 7.7 |
| 27 | 7.8 | 7.9 | 7.8 | 8.1 | 8.1 | 8.7 | 7.3 | 7.2 | 7.2 | 7.7 | 7.7 | 7.8 |
| 28 | 7.9 | 7.9 | 7.8 | 8.0 | 8.0 | 7.7 | 7.2 | 7.2 | 7.2 | 7.6 | 7.7 | 7.8 |
| 29 | 7.9 | ....... | 7.8 | 7.8 | 7.8 | 7.5 | 7.3 | 7.2 | 7.2 | 7.6 | 7.7 | 7.8 |
| 30 | 7.9 | ....... | 7.8 | 13.0 | 7.8 | 7.4 | 7.3 | 7.2 | 7.2 | 7.6 | 7.7 | 7.8 |
| 31 | 7.9 | ....... | 7.8 | ....... | 7.8 | ....... | 7.4 | 7.2 | ....... | 7.6 | ....... | 7.8 |

## BARTONS SPRINGS NEAR AUSTIN, TEX.

These springs are located about 2 miles from Austin and are similar in behavior and in flow to the Comal, San Felipe, and San Marcos. They respond in increased flow to the rainfall in the Edwards Plateau, but this response is always delayed for some months. About a quarter of a mile from the head of the springs the Walsh spring was formerly active and operated a small mill, but it ceased flowing several years ago. In the wet season of 1900 it revived and continued flowing till the early part of 1901, when it again ceased, continuing dry till the early part of 1903. June 6, 1903, the flow of the Walsh spring was 8.5 second-feet, but it stopped flowing in the latter part of 1903 and has since remained dry.

*Discharge measurements of Bartons Springs near Austin, Tex., 1894–1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| 1894 | C. C. Babb | 17 |
| 1895 | do | 25 |
| March, 1898 | T. U. Taylor | 20 |
| May, 1898 | do | 30 |
| August, 1900 | do | 69 |
| December, 1900 | do | 33 |
| June, 1902 | do | 19 |
| August, 1902 | do | 19 |
| June, 1903 | A. A. Cother | 69 |
| June, 1904 | T. U. Taylor | 43 |
| July, 1905 | H. H. Fox | 65 |

## GUADALUPE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Guadalupe River rises in the southern-central part of Texas, flows southeastward, and empties into San Antonio Bay. During the summer of 1902 its discharge was the least in its observed history, causing much loss above New Braunfels, where half a dozen power plants were forced to shut down or to run on short time. The flow at this time was so low that special efforts were made to obtain measurements at several points along its course.

### GUADALUPE RIVER NEAR CUERO, TEX.

The Guadalupe, while the best water-power stream in Texas, has a drainage area above Cuero of only 5,100 square miles. Its efficiency is due almost entirely to the canal at New Braunfels. Below New Braunfels the largest tributary is San Marcos River.

This station was established by Thomas U. Taylor December 26, 1902. The original location was at the dam at Carl Buchel's power house, 3 miles north of Cuero, Tex. As it proved impossible to measure flood discharges at this point, a new station was established in July, 1903, at the bridge of the San Antonio and Aransas Pass Railroad 3 miles west of Cuero.

The channel is straight and has a width of 125 feet at low stages. The right bank is low and overflows for several hundred feet at high stages. The section is deep and the flow is sluggish. The bed is composed of soft material and may change somewhat.

Discharge measurements are made from the highway bridge, 200 feet below the railway bridge, when the gage is above 8 feet, but at lower stages the discharge is measured on the crest of the Buchel dam, 3 miles upstream, where the owners cooperate by shutting off the turbines and forcing the water over the crest of the dam. The crest of this dam is 140 feet long and 4 feet wide, and the depth of the water at the upper edge of the crest of the dam is about 1 foot. The discharge at this stage was found to be 407 second-feet. In the usual weir formula, where $Q=c\,b\,h^{\frac{3}{2}}$, this would give a value of 2.9 for $C$. The initial point for soundings at the bridge is the east face of the tubular pier under the west end of the highway bridge.

A standard chain gage is attached to the bridge; length of chain, 46.20 feet. During 1905 the gage was read twice each day by Robert Miller, jr. Bench marks were established as follows: (1) The top of the tie in the third panel from the east end of the bridge; elevation, 50.00 feet. (2) The seat of the valve, about 100 feet from the pump house, on the line of pipe that leads from the pump to the water tank; elevation, 44.85 feet. (3) The top of a vertical iron rod buried in the ground 4 feet east of a mulberry tree near the left end of the bridge; elevation, 42.18 feet. Elevations refer to the datum of the gage.

A measurement made at this station August 5, 1905, by T. U. Taylor, gave the following results: Gage height, 6.3 feet; discharge, 754 second-feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 84, p 156; 99, p 337; 132, pp 45–46.
Discharge: 66, p 62; 99, p 338; 132, p 46.
Discharge, monthly: 99, p 340; 132, p 49.
Gage heights: 99, pp 338–339; 132, p 47.
Rating table: 99, p 339; 132, p 48.

*Daily gage height, in feet, of Guadalupe River near Cuero, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10.3 | 6.3 | 6.48 | 7.05 | 15.4 | 8.42 | 8.17 | 6.3 | 6.4 | 6.15 | 6.1 | 6.2 |
| 2 | 7.4 | 6.3 | 6.43 | 7.0 | 20.1 | 8.65 | 7.45 | 6.27 | 6.45 | 6.05 | 6.15 | 6.15 |
| 3 | 6.85 | 6.35 | 6.35 | 7.1 | 21.65 | 8.8 | 7.3 | 6.25 | 6.5 | 6.5 | 6.15 | 6.1 |
| 4 | 6.55 | 6.35 | 6.3 | 7.52 | 22.75 | 8.75 | 7.27 | 6.3 | 6.6 | 6.35 | 6.25 | 6.13 |
| 5 | 6.45 | 6.4 | 6.3 | 9.85 | 18.35 | 7.95 | 7.35 | 6.25 | 6.65 | 6.5 | 6.22 | 6.17 |
| 6 | 6.5 | 6.4 | 6.3 | 11.25 | 12.85 | 7.85 | 8.15 | 6.17 | 6.4 | 6.3 | 6.15 | 6.23 |
| 7 | 6.5 | 6.4 | 6.35 | 9.52 | 11.95 | 7.75 | 8.0 | 6.37 | 6.25 | 6.2 | 6.17 | 6.25 |
| 8 | 6.5 | 6.38 | 6.5 | 8.92 | 11.35 | 7.7 | 7.9 | 6.42 | 6.2 | 6.27 | 6.25 | 6.3 |
| 9 | 6.5 | 6.38 | 7.8 | 8.58 | 10.98 | 7.62 | 7.72 | 6.45 | 6.17 | 6.15 | 6.6 | 6.28 |
| 10 | 6.5 | 6.4 | 8.13 | 8.38 | 10.45 | 7.6 | 11.7 | 6.42 | 6.2 | 6.27 | 11.8 | 6.3 |
| 11 | 6.6 | 6.55 | 7.9 | 8.4 | 9.9 | 7.5 | 15.8 | 6.45 | 6.27 | 6.1 | 10.9 | 6.28 |
| 12 | 6.72 | 6.6 | 6.75 | 8.85 | 9.55 | 7.4 | 13.15 | 6.42 | 6.3 | 6.17 | 8.65 | 6.25 |
| 13 | 7.45 | 6.55 | 6.55 | 8.93 | 9.58 | 7.27 | 9.9 | 6.4 | 6.3 | 5.95 | 7.4 | 6.2 |
| 14 | 7.95 | 6.4 | 6.65 | 8.35 | 10.55 | 7.25 | 8.55 | 6.4 | 6.27 | 6.0 | 7.22 | 6.23 |
| 15 | 7.5 | 6.45 | 9.45 | 7.95 | 17.93 | 7.25 | 7.45 | 6.42 | 6.15 | 5.9 | 7.0 | 6.5 |
| 16 | 7.0 | 6.4 | 15.8 | 7.88 | 18.45 | 7.27 | 7.0 | 6.45 | 6.0 | 6.0 | 6.85 | 6.5 |
| 17 | 6.55 | 6.4 | 14.6 | 7.83 | 20.9 | 7.17 | 7.05 | 6.45 | 5.9 | 6.1 | 6.56 | 6.53 |
| 18 | 6.5 | 6.35 | 12.25 | 7.73 | 15.52 | 7.2 | 6.85 | 6.42 | 6.05 | 6.2 | 6.55 | 6.55 |
| 19 | 6.5 | 14.95 | 10.85 | 7.55 | 9.98 | 7.05 | 6.85 | 6.42 | 6.0 | 6.15 | 6.5 | 6.6 |
| 20 | 6.5 | 13.85 | 11.85 | 7.45 | 9.1 | 7.05 | 6.77 | 6.45 | 6.1 | 6.05 | 6.5 | 6.55 |
| 21 | 6.5 | 13.0 | 10.55 | 7.3 | 8.85 | 6.9 | 6.57 | 6.72 | 6.2 | 6.15 | 6.4 | 6.48 |
| 22 | 6.5 | 9.95 | 11.65 | 7.38 | 8.67 | 7.67 | 6.47 | 6.45 | 6.25 | 6.05 | 6.47 | 6.45 |
| 23 | 6.45 | 7.95 | 14.2 | 7.42 | 8.55 | 8.15 | 6.4 | 6.30 | 6.15 | 6.15 | 6.65 | 6.38 |
| 24 | 6.4 | 7.35 | 10.25 | 23.25 | 8.47 | 8.1 | 6.52 | 6.55 | 6.2 | 6.1 | 6.85 | 6.3 |
| 25 | 6.37 | 6.7 | 7.4 | 21.9 | 8.3 | 7.4 | 6.52 | 6.35 | 6.25 | 6.15 | 6.3 | 6.22 |
| 26 | 6.3 | 6.6 | 7.5 | 23.25 | 8.37 | 7.75 | 6.52 | 6.15 | 6.25 | 6.05 | 6.2 | 6.22 |
| 27 | 6.3 | 6.6 | 7.5 | 24.3 | 8.17 | 9.35 | 6.47 | 6.3 | 6.27 | 6.1 | 6.25 | 6.28 |
| 28 | 6.25 | 6.6 | 7.62 | 23.45 | 8.25 | 12.65 | 6.42 | 6.27 | 6.3 | 6.17 | 6.3 | 6.22 |
| 29 | 6.2 | ....... | 7.92 | 24.9 | 8.37 | 14.87 | 6.4 | 6.25 | 6.25 | 6.1 | 6.35 | 6.15 |
| 30 | 6.2 | ....... | 7.9 | 24.05 | 8.3 | 11.9 | 6.3 | 6.22 | 6.1 | 6.25 | 6.3 | 6.1 |
| 31 | 6.25 | ....... | 7.5 | ....... | 8.37 | ....... | 6.27 | 6.27 | ....... | 6.15 | ....... | 6.15 |

*Station rating table for Guadalupe River near Cuero, Tex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.00 | 580 | 8.00 | 1,280 | 10.00 | 1,980 | 14.00 | 3,400 |
| 6.10 | 615 | 8.10 | 1,315 | 10.20 | 2,050 | 14.20 | 3,480 |
| 6.20 | 650 | 8.20 | 1,350 | 10.40 | 2,120 | 14.40 | 3,560 |
| 6.30 | 685 | 8.30 | 1,385 | 10.60 | 2,190 | 14.60 | 3,640 |
| 6.40 | 720 | 8.40 | 1,420 | 10.80 | 2,260 | 14.80 | 3,720 |
| 6.50 | 755 | 8.50 | 1,455 | 11.00 | 2,330 | 15.00 | 3,800 |
| 6.60 | 790 | 8.60 | 1,490 | 11.20 | 2,400 | 15.50 | 4,000 |
| 6.70 | 825 | 8.70 | 1,525 | 11.40 | 2,470 | 16.00 | 4,200 |
| 6.80 | 860 | 8.80 | 1,560 | 11.60 | 2,540 | 16.50 | 4,400 |
| 6.90 | 895 | 8.90 | 1,595 | 11.80 | 2,610 | 17.00 | 4,650 |
| 7.00 | 930 | 9.00 | 1,630 | 12.00 | 2,680 | 17.50 | 4,900 |
| 7.10 | 965 | 9.10 | 1,665 | 12.20 | 2,750 | 18.00 | 5,150 |
| 7.20 | 1,000 | 9.20 | 1,700 | 12.40 | 2,820 | 18.50 | 5,440 |
| 7.30 | 1,035 | 9.30 | 1,735 | 12.60 | 2,890 | 19.00 | 5,740 |
| 7.40 | 1,070 | 9.40 | 1,770 | 12.80 | 2,960 | 20.00 | 6,340 |
| 7.50 | 1,105 | 9.50 | 1,805 | 13.00 | 3,030 | 21.00 | 7,040 |
| 7.60 | 1,140 | 9.60 | 1,840 | 13.20 | 3,100 | 22.00 | 7,840 |
| 7.70 | 1,175 | 9.70 | 1,875 | 13.40 | 3,170 | 23.00 | 8,680 |
| 7.80 | 1,210 | 9.80 | 1,910 | 13.60 | 3,240 | 24.00 | 9,630 |
| 7.90 | 1,245 | 9.90 | 1,945 | 13.80 | 3,320 | 25.00 | 10,690 |

The above table is based on one discharge measurement made during 1905 and measurements prior to 1904. It is well defined. The above table was used for 1903.

*Estimated monthly discharge of Guadalupe River near Cuero, Tex., for 1905.*

[Drainage area, 5,100 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,085 | 650 | 840 | 51,650 | 0.165 | 0.190 |
| February | 3,780 | 685 | 1,094 | 60,780 | .215 | .224 |
| March | 4,120 | 685 | 1,530 | 94,080 | .300 | .346 |
| April | 10,580 | 930 | 3,192 | 189,900 | .626 | .698 |
| May | 8,455 | 1,340 | 2,997 | 184,300 | .588 | .678 |
| June | 3,748 | 895 | 1,378 | 82,000 | .270 | .301 |
| July | 4,120 | 674 | 1,207 | 74,220 | .237 | .273 |
| August | 832 | 632 | 708 | 43,530 | .139 | .160 |
| September | 808 | 545 | 666 | 39,630 | .131 | .146 |
| October | 755 | 545 | 634 | 38,980 | .124 | .143 |
| November | 2,610 | 615 | 884 | 52,600 | .173 | .193 |
| December | 790 | 615 | 684 | 42,060 | .134 | .154 |
| The year | 10,580 | 545 | 1,318 | 953,700 | .258 | 3.51 |

## COMAL RIVER AT NEW BRAUNFELS, TEX.

Comal River has been fully described in Water-Supply Papers, Nos. 71 and 105. Its source is in the numerous big springs that issue from the foothills west of New Braunfels, Tex. The joint discharge of these forms Comal River at the junction of Comal Springs Creek and Comal Creek. The water from the head springs naturally flows down Comal Springs Creek, but a gravel dam deflects part of this flow into the

Landa mill race. These waters again join about 4 miles above the highway bridge north of the court-house, forming Comal River. The following table shows the result of current-meter measurements on Comal River at various times:

*Discharge measurements of Comal River at New Braunfels, Tex., 1895–1905.*

| Date. | Hydrographer. | Discharge. | Remarks. |
|---|---|---|---|
| | | *Second-feet.* | |
| 1895 | C. C. Babb | 328 | At highway bridge. |
| 1898 | T. U. Taylor | 320 | Do. |
| 1899 | .....do | 310 | In park. |
| 1900 | .....do | 374 | Do. |
| 1901 | .....do | 343 | Do. |
| 1902 | .....do | 333 | Do. |
| 1903 | .....do | 412 | In park (recent rains). |
| 1904 | .....do | 375 | In park. |
| 1905 | .....do | 390 | Do. |

## SAN ANTONIO RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

San Antonio River rises about 3 miles north of the mission of San Fernando, the geographic center of the city of San Antonio. The underground source of San Antonio River and of the artesian wells in the vicinity is the same. The flow of the headwaters is extremely variable, as is seen from the record at San Antonio.

### SAN ANTONIO RIVER AT SAN ANTONIO, TEX.

About 1885 San Antonio River at San Antonio began to fail, and by the latter part of 1897 the flow above the city had entirely ceased. San Pedro Creek rises in San Pedro Park and has maintained a flow of 9 second-feet for several years. This joins San Antonio River just below the city and above the Hot Wells, where many of the measurements are made. This river has gone through the same experience as many of the big springs. There is no doubt that the river and the artesian wells have the same underground source, but the river regained its former efficiency in 1900 shortly after the celebrated flood (Water Supply Paper No. 105); in two years, however, the discharge has dropped to a third of the discharge in 1900. The following table shows the discharge measurements that have been made on this stream:

*Discharge measurements of San Antonio River at San Antonio, Tex., 1895–1905.*

| Date. | Hydrographer. | Discharge. | Remarks. |
|---|---|---|---|
| | | *Second-feet.* | |
| December, 1895 | C. C. Babb | 40 | Upper canal. |
| November, 1896 | .....do | 41 | Do. |
| December, 1897 | T. U. Taylor | 0 | Lower canal. |
| December, 1897 | .....do | 11 | Hot Wells. |
| March, 1898 | .....do | 0 | Lower canal. |
| March, 1898 | .....do | 9 | Hot Wells. |
| June, 1899 | .....do | 0 | Lower canal. |
| June, 1899 | .....do | 10 | Hot Wells. |
| September, 1900 | .....do | 103 | Lower canal. |
| September, 1900 | .....do | 125 | Hot Wells. |
| October, 1901 | .....do | 41 | Do. |
| March, 1904 | .....do | 65 | Do. |
| June, 1904 | .....do | 61 | Do. |
| September, 1905 | .....do | 117 | Do. |

## NUECES RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The two main forks of Nueces River rise in Edwards County, Tex., and flows southward through the rugged mountains of the Edwards Plateau, uniting about 14 miles from Uvalde and about 6 miles above the crossing of the Southern Pacific Railroad. On their way through the mountains both branches are fed by springs and carry perpetually running water from their sources, about 12 miles south of Rock Springs to their junction at the foot of the Edwards Plateau. At about the junction of the branches the usual flow sinks into gravel beds, occasionally reappearing in big, clear pools at points where the gravel has been washed off from the solid bed-rock bottom. Four or five miles below the Southern Pacific Railroad bridge flowing water again appears, the stream along its low land course being fed by numerous springs.

### LEONA RIVER AT UVALDE, TEX.

The flow of Leona River at Uvalde is variable and the river has often stopped flowing altogether near Uvalde. It was dry in 1885, but soon revived and continued flowing till 1893, when it again ceased for a time. Its history at the brickyard crossing, 1½ miles below the town on the road to Pearsall, is given in the following table:

*Discharge measurements of Leona River at Uvalde, Tex., 1885–1905.*

| Date. | Hydrographer. | Discharge. | Remarks. |
|---|---|---|---|
| | | *Second-feet.* | |
| 1885 | | | Flowed. |
| 1893 | | | Did not flow. |
| December, 1895 | C. C. Babb | 11 | |
| June, 1899 | T. U. Taylor | | Do. |
| September, 1900 | do | 5 | |
| March, 1904 | do | 22 | |
| August, 1905 | do | 13 | |

## RIO GRANDE DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The source of the Rio Grande is in the snow masses of the high peaks of the continental divide in Hinsdale and Mineral counties in southwestern Colorado. The main stream flows in an easterly direction for about 75 miles, receiving numerous tributaries from the mountainous region through which it passes. At Del Norte the stream channel leaves a narrow canyon-like valley and enters the San Luis Valley. From Del Norte the general course is southeasterly for about 75 miles to a point 20 miles east of Antonito, where it crosses the Colorado-New Mexico State line. Four miles above the State line the Rio Grande enters a canyon, locally known as the Rio Grande Canyon, and continues through it to a short distance below Embudo, N. Mex., where the canyon walls retreat rapidly, especially on the west side, giving room for a border of irregular hills between the higher mesa walls and the flood plain adjacent to the river. This is the beginning of Espanola Valley, about 3 or 4 miles in width, which extends to White Rock Canyon, about 25 miles below, and through which the Rio Grande flows for 30 miles. Again the canyon walls recede, and the river enters Albuquerque Valley, which averages from 1 to 3 miles in width and continues down to about Socorro, N. Mex. Throughout its course in New Mexico the general direction of the Rio Grande is southward to El Paso; thence it is southeasterly to the Gulf of Mexico.

From the high mountains which surround this basin come a large number of small streams, some of which unite into creeks of considerable size, while others sink and gradually disappear into the coarse soil of the valley bottom. Below Del Norte few streams of importance enter the river with the exception of the Chama in New Mexico and the Pecos in Texas, as nearly all those which issue from the mountains lose their water, except in flood periods, in the sandy plains before they reach the main channel. Rio Conchos is the principal tributary from the Mexican side.

The limited data on precipitation collected by the United States Weather Bureau show the mean annual rainfall to be 25 inches in the mountainous portion of the drainage. This diminishes to 10 inches in the foothills and lower portions of the drainage.

The determination of the amount of water in the Rio Grande is of importance, both on account of its use in irrigation and from its bearing upon interstate and international distribution of water. Most of the New Mexico and Texas stations down to Eagle Pass are maintained by the United States section of the International (Water) Boundary Commission. The data are collected by W. W. Follett, consulting engineer for the Commission, and have been furnished through the courtesy of Gen. Anson Mills, Commissioner. On account of the shifting character of the river beds at the International (Water) Boundary stations, no rating tables have been prepared. The estimated monthly discharges are from daily discharges computed by Mr. Follett directly from the discharge measurements.

The five stations from Laredo down (Laredo, Roma, Brownsville, Salado near Guerrero, and San Juan at Santa Rosalie Ranch) are maintained by the Mexican section of the Commission.

## RIO GRANDE NEAR DEL NORTE, COLO.

Measurements and observations were first begun in the vicinity of Del Norte in 1889 by George T. Quinby. The object of the measurements was to obtain the flow of the river before water was diverted for the agricultural region of San Luis Valley, and by a comparison of this with the figures obtained at Embudo to acquire data as to the effect of the numerous ditches taking out water between the two points. The river 25 miles above Del Norte flows out of the canyon at Wagon Wheel Gap. Little water, however, is diverted until the edge of the San Luis Valley is reached, the largest canal heading near the town of Del Norte. During freshets the river divides into a number of channels, making it difficult to obtain measurements near town. In order to avoid the expense of establishing a station during time of high water the first measurements—those about June 1—were made from several bridges crossing the numerous branches. The results were not wholly satisfactory, and June 25 a station was established above the branches. Later a locality about 2 miles farther up was chosen. Records are continuous for a period of sixteen years.

The station is about 2 miles west of Del Norte, above the main canal taking water from the Rio Grande, and is above all the irrigating ditches of importance.

The stream course, which is of uniform section, is straight for 100 yards both above and below the cable. The bed is composed of small bowlders and cobblestones, and hitherto has been considered permanent. However, the high water of June, 1905, altered the section considerably along the right side. The present section will probably be permanent for a long period of years and can change only during extreme high water. The left bank is low and of gradual slope, and is composed of cobblestones and gravel with a fringe of small cottonwood trees, and overflows at high water. The right bank is 6 feet above low water, of about 45° slope, and is composed of bowlders, cobblestones, and gravel. The extreme high water of 1905 overflowed this bank and extended over the entire bottom land to the right for a distance of half a mile. There is but one channel at all stages, and it is about 75 feet wide and of very regular section. Gage heights range from 1 to 5 feet save at extreme high water. The current is swift at low water, and exceptionally so during high water. Very accurate results may be secured at this station.

Discharge measurements were first made from a flatboat controlled by a cable across the river. They are now made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is on the right bank of river, and is indicated by a tag on the tagged wire, 22 feet from the tree to which the cable is anchored.

Several inclined gages have been used from time to time. The datum of each has been the same, and the location practically so. The lower part of the present gage is an inclined rod at the cable, and the upper part a vertical post, on the right bank. During 1905 the gage was read once each day by Richard D. Adams. The bench mark is a United States Geological Survey iron bench mark post set in the ground 25 feet south of the gage; elevation, 8.25 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description:** Ann 14, ii, pp 110–111; 18, iv, p 246; Bull 131, pp 41–42; 140, p 170; WS 16, p 127; 28, p 120; 37, pp 277–278; 50, p 347; 66, p 65; 84, pp 194–195; 99, pp 400–401; 132, p 52.

**Discharge:** Ann 18, iv, p 246; Bull 131, p 91; 140, p 170; WS 16, p 127; 28, p 129; 37, p 278; 50, p 347; 66, p 65; 84, p 195; 99, p 401; 132, p 53.

**Discharge, monthly:** Ann 11, ii, p 98; 12, ii, pp 349, 360; 13, iii, p 94; 14, ii, p 11; 18, iv, p 247–248; 19, iv, p 383; 20, iv, pp 358, 360–364; 21 iv, p 256; 22, iv, p 347; WS 75, p 153; 84, p 196; 99, p 402; 132, p 54.

**Discharge, yearly:** Ann 13, iii, p 99; 20, iv, p 57.

**Gage heights:** Bull 131, pp 42–43; 140, p 170; WS 11, p 64; 16, p 127; 28, p 126; 37, p 278; 50, p 347; 66, p 65; 84, pp 195–196; 99, p 401; 132, p 53.

**Hydrographs:** Ann 12, ii, p 250; 18, iv, p 249; 19, iv, p 384; 20, iv, p 365; 21, iv, p 256; 22, iv, p 348.

**Rainfall and run-off relation:** Ann 20, iv, p 359.

**Rating tables:** Ann 18, iv, p 247; 19, iv, p 383; WS 28, p 130; 39, p 450; 52, p 519; 66, p 173; 84, p 196; 99, p 402; 132, p 54.

*Discharge measurements of Rio Grande near Del Norte, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| **April 20** | **R. I. Meeker** | 132 | 184 | 3.46 | 2.08 | 638 |
| **June 28** | **do** | 156 | 550 | 6.23 | 3.90 | 3,428 |
| **July 25** | **do** | 137 | 224 | 3.32 | 1.70 | 744 |
| **September 18** | **do** | 122 | 130 | 2.15 | 1.00 | 280 |

*Daily gage height, in feet, of Rio Grande near Del Norte, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 3.8 | 6.25 | 3.2 | 1.95 | 1.2 | 1.9 | 1.1 | 1.0 |
| 2 | 1.45 | 3.9 | 6.7 | 3.05 | 1.9 | 1.2 | 1.6 | 1.1 | 1.0 |
| 3 | 1.5 | 3.2 | 6.9 | 2.9 | 1.9 | 1.2 | 1.5 | 1.1 | 1.0 |
| 4 | 1.45 | 2.9 | 7.0 | 2.75 | 1.8 | 1.25 | 1.5 | 1.1 | 1.0 |
| 5 | 1.45 | 2.8 | 7.05 | 2.55 | 1.85 | 1.25 | 1.4 | 1.1 | 1.0 |
| 6 | 1.75 | 2.6 | 6.1 | 2.35 | 1.9 | 1.3 | 1.4 | 1.1 | 1.0 |
| 7 | 1.7 | 2.7 | 6.2 | 2.3 | 1.9 | 1.25 | 1.35 | 1.1 | 1.0 |
| 8 | 1.8 | 2.9 | 6.45 | 2.25 | 1.85 | 1.2 | 1.3 | 1.1 | 1.0 |
| 9 | 2.5 | 3.4 | 6.4 | 2.2 | 1.75 | 1.2 | 1.25 | 1.1 | 1.0 |
| 10 | 2.5 | 3.25 | 6.3 | 2.15 | 1.6 | 1.25 | 1.25 | 1.1 | 1.0 |
| 11 | 2.1 | 2.8 | 6.0 | 2.1 | 1.7 | 1.2 | 1.2 | 1.1 | 1.0 |
| 12 | 2.0 | 2.9 | 5.9 | 2.0 | 1.75 | 1.15 | 1.2 | 1.0 | 1.0 |
| 13 | 1.95 | 3.1 | 5.7 | 2.0 | 1.6 | 1.1 | 1.2 | 1.0 | 1.0 |
| 14 | 2.0 | 3.1 | 5.7 | 1.95 | 1.55 | 1.1 | 1.2 | 1.0 | 1.0 |
| 15 | 2.1 | 3.7 | 5.65 | 1.95 | 1.45 | 1.1 | 1.2 | 1.0 | 1.0 |
| 16 | 2.15 | 4.2 | 5.55 | 1.8 | 1.4 | 1.15 | 1.2 | 1.0 | 1.0 |
| 17 | 2.15 | 4.9 | 5.2 | 1.85 | 1.35 | 1.0 | 1.2 | 1.0 | 1.0 |
| 18 | 2.1 | 5.1 | 5.0 | 1.85 | 1.3 | 1.0 | 1.25 | 1.0 | 1.0 |

From the high mountains which surround this basin come a large number of small streams, some of which unite into creeks of considerable size, while others sink and gradually disappear into the coarse soil of the valley bottom. Below Del Norte few streams of importance enter the river with the exception of the Chama in New Mexico and the Pecos in Texas, as nearly all those which issue from the mountains lose their water, except in flood periods, in the sandy plains before they reach the main channel. Rio Conchos is the principal tributary from the Mexican side.

The limited data on precipitation collected by the United States Weather Bureau show the mean annual rainfall to be 25 inches in the mountainous portion of the drainage. This diminishes to 10 inches in the foothills and lower portions of the drainage.

The determination of the amount of water in the Rio Grande is of importance, both on account of its use in irrigation and from its bearing upon interstate and international distribution of water. Most of the New Mexico and Texas stations down to Eagle Pass are maintained by the United States section of the International (Water) Boundary Commission. The data are collected by W. W. Follett, consulting engineer for the Commission, and have been furnished through the courtesy of Gen. Anson Mills, Commissioner. On account of the shifting character of the river beds at the International (Water) Boundary stations, no rating tables have been prepared. The estimated monthly discharges are from daily discharges computed by Mr. Follett directly from the discharge measurements.

The five stations from Laredo down (Laredo, Roma, Brownsville, Salado near Guerrero, and San Juan at Santa Rosalie Ranch) are maintained by the Mexican section of the Commission.

### RIO GRANDE NEAR DEL NORTE, COLO.

Measurements and observations were first begun in the vicinity of Del Norte in 1889 by George T. Quinby. The object of the measurements was to obtain the flow of the river before water was diverted for the agricultural region of San Luis Valley, and by a comparison of this with the figures obtained at Embudo to acquire data as to the effect of the numerous ditches taking out water between the two points. The river 25 miles above Del Norte flows out of the canyon at Wagon Wheel Gap. Little water, however, is diverted until the edge of the San Luis Valley is reached, the largest canal heading near the town of Del Norte. During freshets the river divides into a number of channels, making it difficult to obtain measurements near town. In order to avoid the expense of establishing a station during time of high water the first measurements—those about June 1—were made from several bridges crossing the numerous branches. The results were not wholly satisfactory, and June 25 a station was established above the branches. Later a locality about 2 miles farther up was chosen. Records are continuous for a period of sixteen years.

The station is about 2 miles west of Del Norte, above the main canal taking water from the Rio Grande, and is above all the irrigating ditches of importance.

The stream course, which is of uniform section, is straight for 100 yards both above and below the cable. The bed is composed of small bowlders and cobblestones, and hitherto has been considered permanent. However, the high water of June, 1905, altered the section considerably along the right side. The present section will probably be permanent for a long period of years and can change only during extreme high water. The left bank is low and of gradual slope, and is composed of cobblestones and gravel with a fringe of small cottonwood trees, and overflows at high water. The right bank is 6 feet above low water, of about 45° slope, and is composed of bowlders, cobblestones, and gravel. The extreme high water of 1905 overflowed this bank and extended over the entire bottom land to the right for a distance of half a mile. There is but one channel at all stages, and it is about 75 feet wide and of very regular section. Gage heights range from 1 to 5 feet save at extreme high water. The current is swift at low water, and exceptionally so during high water. Very accurate results may be secured at this station.

Discharge measurements were first made from a flatboat controlled by a cable across the river. They are now made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is on the right bank of river, and is indicated by a tag on the tagged wire, 22 feet from the tree to which the cable is anchored.

Several inclined gages have been used from time to time. The datum of each has been the same, and the location practically so. The lower part of the present gage is an inclined rod at the cable, and the upper part a vertical post, on the right bank. During 1905 the gage was read once each day by Richard D. Adams. The bench mark is a United States Geological Survey iron bench mark post set in the ground 25 feet south of the gage; elevation, 8.25 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description:** Ann 14, ii, pp 110–111; 18, iv, p 246; Bull 131, pp 41–42; 140, p 170; WS 16, p 127; 28, p 120; 37, pp 277–278; 50, p 347; 66, p 65; 84, pp 194–195; 99, pp 400–401; 132, p 52.

**Discharge:** Ann 18, iv, p 246; Bull 131, p 91; 140, p 170; WS 16, p 127; 28, p 129; 37, p 278; 50, p 347; 66, p 65; 84, p 195; 99, p 401; 132, p 53.

**Discharge, monthly:** Ann 11, ii, p 98; 12, ii, pp 349, 360; 13, iii, p 94; 14, ii, p 11; 18, iv, p 247–248; 19, iv, p 383; 20, iv, pp 358, 360–364; 21 iv, p 256; 22, iv, p 347; WS 75, p 153; 84, p 196; 99, p 402; 132, p 54.

**Discharge, yearly:** Ann 13, iii, p 99; 20, iv, p 57.

**Gage heights:** Bull 131, pp 42–43; 140, p 170; WS 11, p 64; 16, p 127; 28, p 126; 37, p 278; 50, p 347; 66, p 65; 84, pp 195-196; 99, p 401; 132, p 53.

**Hydrographs:** Ann 12, ii, p 250; 18, iv, p 249; 19, iv, p 384; 20, iv, p 365; 21, iv, p 256; 22, iv, p 348.

**Rainfall and run-off relation:** Ann 20, iv, p 359.

**Rating tables:** Ann 18, iv, p 247; 19, iv, p 383; WS 28, p 130; 39, p 450; 52, p 519; 66, p 173; 84, p 196; 99, p 402; 132, p 54.

*Discharge measurements of Rio Grande near Del Norte, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 20 | R. I. Meeker | 132 | 184 | 3.46 | 2.08 | 638 |
| June 28 | do | 156 | 550 | 6.23 | 3.90 | 3,428 |
| July 25 | do | 137 | 224 | 3.32 | 1.70 | 744 |
| September 18 | do | 122 | 130 | 2.15 | 1.00 | 280 |

*Daily gage height, in feet, of Rio Grande near Del Norte, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 3.8 | 6.25 | 3.2 | 1.95 | 1.2 | 1.9 | 1.1 | 1.0 |
| 2 | 1.45 | 3.9 | 6.7 | 3.05 | 1.9 | 1.2 | 1.6 | 1.1 | 1.0 |
| 3 | 1.5 | 3.2 | 6.9 | 2.9 | 1.9 | 1.2 | 1.5 | 1.1 | 1.0 |
| 4 | 1.45 | 2.9 | 7.0 | 2.75 | 1.8 | 1.25 | 1.5 | 1.1 | 1.0 |
| 5 | 1.45 | 2.8 | 7.05 | 2.55 | 1.85 | 1.25 | 1.4 | 1.1 | 1.0 |
| 6 | 1.55 | 2.6 | 6.1 | 2.35 | 1.9 | 1.3 | 1.4 | 1.1 | 1.0 |
| 7 | 1.7 | 2.7 | 6.2 | 2.3 | 1.9 | 1.25 | 1.35 | 1.1 | 1.0 |
| 8 | 1.8 | 2.9 | 6.45 | 2.25 | 1.85 | 1.2 | 1.3 | 1.1 | 1.0 |
| 9 | •2.5 | 3.4 | 6.4 | 2.2 | 1.75 | 1.2 | 1.25 | 1.1 | 1.0 |
| 10 | 2.5 | 3.25 | 6.3 | 2.15 | 1.6 | 1.25 | 1.25 | 1.1 | 1.0 |
| 11 | 2.1 | 2.8 | 6.0 | 2.1 | 1.7 | 1.2 | 1.2 | 1.1 | 1.0 |
| 12 | 2.0 | 2.9 | 5.9 | 2.0 | 1.75 | 1.15 | 1.2 | 1.0 | 1.0 |
| 13 | 1.95 | 3.1 | 5.7 | 2.0 | 1.6 | 1.1 | 1.2 | 1.0 | 1.0 |
| 14 | 2.0 | 3.1 | 5.7 | 1.95 | 1.55 | 1.1 | 1.2 | 1.0 | 1.0 |
| 15 | 2.1 | 3.7 | 5.65 | 1.95 | 1.45 | 1.1 | 1.2 | 1.0 | 1.0 |
| 16 | 2.15 | 4.2 | 5.55 | 1.8 | 1.4 | 1.05 | 1.2 | 1.0 | 1.0 |
| 17 | 2.15 | 4.9 | 5.2 | 1.85 | 1.35 | 1.0 | 1.2 | 1.0 | 1.0 |
| 18 | 2.1 | 5.1 | 5.0 | 1.85 | 1.3 | 1.0 | 1.25 | 1.0 | 1.0 |

*Daily gage height, in feet, of Rio Grande, near Del Norte, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 19 | 2.3 | 5.6 | 4.8 | 1.9 | 1.25 | 1.0 | 1.25 | 1.0 | 1.0 |
| 20 | 2.1 | 5.7 | 4.7 | 1.9 | 1.25 | 1.0 | 1.2 | 1.0 | 1.0 |
| 21 | 2.5 | 5.5 | 4.6 | 1.95 | 1.2 | 1.0 | 1.2 | 1.0 | 1.0 |
| 22 | 2.15 | 5.8 | 4.2 | 2.0 | 1.15 | 1.0 | 1.2 | 1.0 | 1.0 |
| 23 | 2.2 | 6.2 | 4.1 | 1.9 | 1.15 | 1.0 | 1.2 | 1.0 | 1.0 |
| 24 | 2.1 | 6.0 | 4.0 | 1.8 | 1.2 | 1.0 | 1.2 | 1.0 | 1.0 |
| 25 | 2.1 | 6.5 | 3.85 | 1.7 | 1.3 | 1.1 | 1.2 | .8 | 1.0 |
| 26 | 2.1 | 6.0 | 3.75 | 1.65 | 1.25 | 1.2 | 1.2 | .8 | 1.0 |
| 27 | 2.4 | 5.9 | 3.45 | 1.6 | 1.25 | 1.15 | 1.2 | .8 | 1.0 |
| 28 | 2.6 | 6.0 | 3.9 | 1.7 | 1.2 | 1.1 | 1.2 | .9 | 1.0 |
| 29 | 3.0 | 4.5 | 3.65 | 1.8 | 1.25 | 1.05 | 1.2 | 1.0 | 1.0 |
| 30 | 3.25 | 4.9 | 3.5 | 2.15 | 1.3 | 2.27 | 1.15 | 1.0 | 1.0 |
| 31 | ........ | 5.6 | ........ | 2.0 | 1.25 | ........ | 1.15 | ........ | 1.0 |

*Station rating table for Rio Grande near Del Norte, Colo., from April 1 to June 5, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 290 | 2.60 | 1,135 | 3.80 | 2,400 | 5.00 | 4,010 |
| 1.50 | 345 | 2.70 | 1,225 | 3.90 | 2,520 | 5.20 | 4,330 |
| 1.60 | 405 | 2.80 | 1,315 | 4.00 | 2,640 | 5.40 | 4,650 |
| 1.70 | 465 | 2.90 | 1,410 | 4.10 | 2,760 | 5.60 | 4,990 |
| 1.80 | 535 | 3.00 | 1,510 | 4.20 | 2,890 | 5.80 | 5,410 |
| 1.90 | 605 | 3.10 | 1,610 | 4.30 | 3,030 | 6.00 | 5,890 |
| 2.00 | 675 | 3.20 | 1,710 | 4.40 | 3,170 | 6.20 | 6,450 |
| 2.10 | 745 | 3.30 | 1,810 | 4.50 | 3,310 | 6.40 | 7,100 |
| 2.20 | 815 | 3.40 | 1,920 | 4.60 | 3,450 | 6.60 | 7,850 |
| 2.30 | 890 | 3.50 | 2,040 | 4.70 | 3,590 | 6.80 | 8,730 |
| 2.40 | 970 | 3.60 | 2,160 | 4.80 | 3,730 | 7.00 | 9,760 |
| 2.50 | 1,050 | 3.70 | 2,280 | 4.90 | 3,870 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made previous to the high water of June, 1905. It is not well defined. Below gage height 5.5 feet it is the same as the 1904 table.

*Station rating table for Rio Grande near Del Norte, Colo., from June 6 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| [a]1.00 | 290 | 2.20 | 1,150 | 3.40 | 2,670 | 4.60 | 4,630 |
| 1.10 | 330 | 2.30 | 1,260 | 3.50 | 2,820 | 4.70 | 4,820 |
| 1.20 | 380 | 2.40 | 1,370 | 3.60 | 2,970 | 4.80 | 5,010 |
| 1.30 | 440 | 2.50 | 1,480 | 3.70 | 3,120 | 4.90 | 5,200 |
| 1.40 | 500 | 2.60 | 1,600 | 3.80 | 3,280 | 5.00 | 5,400 |
| 1.50 | 560 | 2.70 | 1,720 | 3.90 | 3,440 | 5.20 | 5,810 |
| 1.60 | 630 | 2.80 | 1,850 | 4.00 | 3,600 | 5.40 | 6,230 |
| 1.70 | 700 | 2.90 | 1,980 | 4.10 | 3,760 | 5.60 | 6,670 |
| 1.80 | 780 | 3.00 | 2,110 | 4.20 | 3,930 | 5.80 | 7,110 |
| 1.90 | 860 | 3.10 | 2,250 | 4.30 | 4,100 | 6.00 | 7,550 |
| 2.00 | 950 | 3.20 | 2,390 | 4.40 | 4,270 | 6.20 | 8,030 |
| 2.10 | 1,050 | 3.30 | 2,530 | 4.50 | 4,450 | 6.40 | 8,510 |

[a] 0.8 = 220; 0.9 = 255.

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during the latter part of 1905. Estimates based on this table are only approximate.

*Estimated monthly discharge of Rio Grande near Del Norte, Colo., for 1905.*

[Drainage area, 1,400 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 1,760 | 318 | 760 | 45,220 | 0.543 | 0.606 |
| May | 7,460 | 1,135 | 3,411 | 209,700 | 2.44 | 2.81 |
| June | 10,030 | 2,745 | 6,090 | 362,400 | 4.35 | 4.85 |
| July | 2,390 | 630 | 1,091 | 67,080 | .779 | .898 |
| August | 905 | 355 | 578 | 35,540 | .413 | .476 |
| September | 1,227 | 290 | 376 | 22,370 | .269 | .300 |
| October | 860 | 355 | 430 | 26,440 | .307 | .354 |
| November | 330 | 220 | 296 | 17,610 | .211 | .235 |
| December | 290 | 290 | 290 | 17,830 | .207 | .239 |
| The period | | | | 804,200 | | |

## RIO GRANDE NEAR LOBATOS, COLO.

This station was established June 28, 1899, by A. L. Fellows, and is 13 miles east of Antonio, the nearest railroad station. It is located at the State highway bridge at a point near the Colorado-New Mexico State line, about 10 miles east of Lobatos post-office and in T. 33 N., R. 11 E. The record of flow at this station is of importance to the proposed Government irrigation project near Engle, N. Mex., and also from the fact that it gives the discharge of the river at the Colorado State line, so that it includes practically all of the Colorado drainage.

The cross section above and below the station is fairly uniform and the channel regular, being straight above and below for a considerable distance. The stream channel is a gash cut through the solid lava to a general depth of 40 feet at the bridge. The stream floor is fairly smooth, but is littered with angular fragments of lava that catch and hold a loose, shallow deposit of sand during low water, which prevails during the greater portion of the year. The right bank is a perpendicuar lava cliff. The left bank, composed of loose fragments of lava at the water's edge, slopes gradually up to the lava cliff. The channel can not overflow either bank at this section. At low stages there are usually two channels; during high water there is but one. Gage heights range from 1 to 10 feet. At low water the current is very sluggish; at high water very swift. The center pier obstructs the current very little during high water.

Discharge measurements at high water are made from the downstream side of the bridge, a double span steel structure with cylinder piers at the center of the stream and 300 feet in length.

The initial point for soundings is at the right end of the bridge, downstream side. At low water discharge measurements are made by wading either above or below the bridge.

The gage is a scale on the right side of the downstream pier of the bridge. During 1905 the gage was read twice each day by Román Mondragón. The bench mark is a chiseled point marked "B. M." on the face of the lava bluff at the west end of the bridge; elevation, 7.42 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

**Description:** WS 37, p 279; 50, pp 348–349; 66, p 65; 84, pp 192–193; 99, p 395; 132, p 55.
**Discharge:** WS 37, p 279; 50, p 349; 66, p 65; 84, p 193; 99, p 395; 132, p 55.
**Discharge, monthly:** Ann 21, iv, p 257; 22 iv, p 349; WS 75, p 153; 84, p 194; 99, p 397; 132, p 57.
**Gage heights:** WS 37, p 280; 50, p 349; 66, p 66; 84, p 193; 99, p 396; 132, p 56.
**Hydrographs:** Ann 21, iv, p 257; 22, iv, p 349.
**Rating tables:** WS 39, p 450; 52, p 519; 66, p 173; 84, p 193; 99, p 396; 132, p 56.

*Discharge measurements of Rio Grande near Lobatos, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Feet per second.* | *Feet.* | *Sec.-feet.* |
| April 21 | R. I. Meeker | 234 | 433 | 1.85 | 2.45 | 801 |
| June 23 | .....do | 249 | 1,029 | 3.23 | 4.25 | 3,343 |
| July 26[a] | .....do | 207 | 188 | .36 | 1.12 | 67 |
| September 22 | .....do | 200 | 166 | .28 | 1.00 | 46 |

[a] Made by wading.

*Daily gage height, in feet, of Rio Grande near Lobatos, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | 2.75 | 3.00 | 2.0 | 3.6 | 6.25 | 2.9 | 1.25 | 1.2 | 1.0 | 1.3 | 1.9 |
| 2 | 2.6 | 2.8 | 3.15 | 2.0 | 4.4 | 6.5 | 2.7 | 1.35 | 1.1 | 1.0 | 1.3 | 1.9 |
| 3 | 2.6 | 2.8 | 3.2 | 2.0 | 4.65 | 7.05 | 2.55 | 1.7 | 1.15 | 1.0 | 1.3 | 1.9 |
| 4 | 2.6 | 2.8 | 3.2 | 2.0 | 4.55 | 7.85 | 2.2 | 1.7 | 1.2 | 1.5 | 1.4 | 1.9 |
| 5 | 2.6 | 2.8 | 3.2 | 1.95 | 4.25 | 8.25 | 2.1 | 1.7 | 1.2 | 1.5 | 1.4 | 1.9 |
| 6 | 2.6 | 2.8 | 3.15 | 1.9 | 3.65 | 8.75 | 2.0 | 1.7 | 1.2 | 1.4 | 1.4 | 1.9 |
| 7 | 2.6 | 2.8 | 2.1 | 1.9 | 3.45 | 8.85 | 1.85 | 1.6 | 1.2 | 1.5 | 1.4 | 1.9 |
| 8 | 2.6 | 2.8 | 2.3 | 1.9 | 3.3 | 9.05 | 1.7 | 1.6 | 1.2 | 1.5 | 1.5 | 1.9 |
| 9 | 2.6 | 2.8 | 2.5 | 1.95 | 3.4 | 8.85 | 1.6 | 1.65 | 1.2 | 1.4 | 1.5 | 1.9 |
| 10 | 2.6 | 2.8 | 2.5 | 2.05 | 3.55 | 8.6 | 1.5 | 1.6 | 1.2 | 1.4 | 1.5 | 2.0 |
| 11 | 2.6 | 2.8 | 2.5 | 2.1 | 3.7 | 8.45 | 1.4 | 1.6 | 1.2 | 1.3 | 1.6 | 2.0 |
| 12 | 2.6 | 2.8 | 2.6 | 2.4 | 3.5 | 8.1 | 1.4 | 1.6 | 1.2 | 1.3 | 1.6 | 2.0 |
| 13 | 2.6 | 2.8 | 2.6 | 2.4 | 3.4 | 7.6 | 1.4 | 1.6 | 1.1 | 1.2 | 1.6 | 2.05 |
| 14 | 2.6 | 2.8 | 2.5 | 2.4 | 3.6 | 6.8 | 1.3 | 1.45 | 1.1 | 1.2 | 1.6 | 2.2 |
| 15 | 2.6 | 2.8 | 2.4 | 2.3 | 3.6 | 6.7 | 1.3 | 1.4 | 1.1 | 1.2 | 1.6 | 2.2 |
| 16 | 2.6 | 2.8 | 2.45 | 2.2 | 4.1 | 6.4 | 1.3 | 1.35 | 1.1 | 1.1 | 1.6 | 2.2 |
| 17 | 2.6 | 2.8 | 2.45 | 2.25 | 4.7 | 6.3 | 1.3 | 1.3 | 1.0 | 1.1 | 1.6 | 2.2 |
| 18 | 2.6 | 2.8 | 2.45 | 2.3 | 5.1 | 6.05 | 1.3 | 1.3 | 1.0 | 1.1 | 1.6 | 2.2 |
| 19 | 2.6 | 2.8 | 2.4 | 2.4 | 5.9 | 5.8 | 1.3 | 1.3 | 1.0 | 1.1 | 1.6 | 2.2 |
| 20 | 2.6 | 2.8 | 2.4 | 2.5 | 6.6 | 5.15 | 1.2 | 1.2 | 1.0 | 1.1 | 1.6 | 2.2 |
| 21 | 2.6 | 2.8 | 2.4 | 2.5 | 7.0 | 4.9 | 1.2 | 1.2 | 1.0 | 1.1 | 1.6 | 2.2 |
| 22 | 2.6 | 2.8 | 2.3 | 2.55 | 7.2 | 4.5 | 1.2 | 1.2 | 1.0 | 1.1 | 1.6 | 2.2 |
| 23 | 2.6 | 2.8 | 2.2 | 2.6 | 7.7 | 4.0 | 1.2 | 1.2 | 1.0 | 1.1 | 1.6 | 2.2 |
| 24 | 2.6 | 2.8 | 2.1 | 2.6 | 7.95 | 3.65 | 1.2 | 1.2 | 1.0 | 1.1 | 1.7 | 2.2 |
| 25 | 2.6 | 2.8 | 2.0 | 2.6 | 8.0 | 3.55 | 1.2 | 1.2 | 1.0 | 1.1 | 1.7 | 2.2 |
| 26 | 2.6 | 2.8 | 2.0 | 2.6 | 8.4 | 3.5 | 1.2 | 1.3 | 1.0 | 1.1 | 1.7 | 2.2 |
| 27 | 2.6 | 2.8 | 2.0 | 2.6 | 8.15 | 3.5 | 1.2 | 1.2 | 1.0 | 1.2 | 1.7 | 2.2 |
| 28 | 2.6 | 2.85 | 2.1 | 2.7 | 8.0 | 3.3 | 1.2 | 1.2 | 1.0 | 1.3 | 1.9 | 2.2 |
| 29 | 2.6 | ....... | 2.0 | 3.0 | 7.7 | 3.2 | 1.2 | 1.2 | 1.0 | 1.3 | 1.6 | 2.2 |
| 30 | 2.6 | ....... | 2.0 | 3.3 | 7.1 | 3.0 | 1.2 | 1.2 | 1.0 | 1.3 | 1.85 | 2.2 |
| 31 | 2.6 | ....... | 2.0 | ....... | 6.7 | ....... | 1.2 | 1.2 | ....... | 1.3 | ....... | 2.2 |

## RIO GRANDE NEAR SAN ILDEFONSO, N. M.

This station was established February 3, 1895, by A. P. Davis, and is located at the Denver and Rio Grande Railroad bridge, 9 miles below Espanola and 2 miles from San Ildefonso. The station has been called by the following names: Rio Grande, Buckman, and Water Tank. The data at this station are of especial interest in connection with irrigation projects, owing to the fact that Mexican settlers of this valley divert a considerable volume of water for their cultivated lands. The method of application of water to land by these people is very wasteful. In recent years a number of important modern irrigation systems have been planned and built in the valley in the vicinity of Albuquerque, 40 miles below.

The channel is straight for 150 feet above and 500 feet below the cable. The bed of the stream at the cable is about 200 feet in width, and is composed of lava bowlders, with a shifting deposit of sand and silt, which scours out and changes during very high water and accumulates immediately on its recession. At low water ordinarily the channel finds a narrow passage through this deposit. The right bank is low and composed of lava bowlders with a silt deposit. It overflows at high water. The left bank is scattered with lava bowlders and is the steep side of a mountain partly covered with scattered cedars. There is but one channel at all stages. Gage heights range from 1.5 to 12 feet. During high water it is difficult to secure accurate measurements from the bridge on account of the high velocity of the current and the rough surface. In addition to this, the Denver and Rio Grande Railroad bridge does not cross the river at a right angle to the direction of the current.

At the cable section the water boils considerably at low water. At high water at both sections the velocity is close to 20 feet per second.

Discharge measurements are made from a cable with car and tag line 150 feet above the bridge, to which the gage is attached. At very high water measurements must be made from the railroad bridge. The initial point for soundings at the cable is at the end of the cable on the left side of the stream, where the cable is fastened to two small cedar trees.

The original gage at this station was located on the left bank, 180 feet above the bridge. The inclined portion read from 1 to 10 feet and the vertical portion from 10 to 16 feet. It was found that this gage was not well located, and March 30, 1904, a vertical rod was established on the downstream side of the north pier of the bridge, the datum being 2.019 feet higher than that of the original gage. During the flood of September, 1904, this rod was cut off from the water by the filling in of the channelr October 29, 1904, a standard chain gage was established on the downstream running board of the bridge, at the same datum as the new rod gage; length of chain, 23.28 feet. During 1905 the gage was read twice each day by Joseph Gomez. The bench mark is a United States Geological Survey tablet, set in the top of a granite bowlder, 5 feet square and 2 feet high, located in a clump of cedars on the right bank of the river, about 75 feet from the west end of the north pier of the railroad bridge; elevation, 11.37 feet above the datum of the new gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description**: Ann 18, iv, pp 252-253; Bull 140, pp 175-176; WS 16, p 130; 28, p 120; 37, pp 281-282; 50 pp 350-351; 66, p 67; 84, pp 186-187; 99, p 387, 132, pp 57-58.

**Discharge**: Ann 11, ii, p 107; Ann 18, iv, p 253; Bull 140, p 176; WS 16, p 130; 28, p 129; 37, p 282; 50, p 351; 66, p 67; 84, pp 187-188; 99, pp 387-389; 132, p 59.

**Discharge, monthly**: Ann 18, iv, p 254; 19, iv, p 386; 20, iv, pp 358, 370; 21, iv, p 259; 22, iv, p 351; Bull 140, p 177; WS 75, p 154; 84, p 189; 99, p 390; 132, p 62.

**Discharge, yearly**: Ann 20, iv, p 58.

**Gage heights**: Bull 140, p 176; WS 11, p 66; 16, p 130; 28, p 127; 37, p 282; 50, p 351; 66, p 68; 84, p 188; 99, pp 389-390; 132, p 60.

**Hydrographs**: Ann 18, iv, p 255; 19, iv, p 387; 21, iv, p 260; 22, iv, p 351.

**Rainfall and run-off relation**: Ann 20, iv, p 359.

**Rating tables**: Ann 18, iv, p 253; 19, iv, p 386; Bull 140, p 176; WS 28, p 130; 39, p 451; 66, p 173; 132, p 61.

*Discharge measurements of Rio Grande near San Ildefonso, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 26 | R. I. Meeker | 130 | 709 | 5.82 | 5.45 | 4,126 |
| June 9 | do | 132 | 484 | 6.0 | 4.45 | 2,905 |
| June 30 | do | 132 | 434 | 5.72 | 4.25 | 2,481 |
| July 28 | do | 115 | 171 | 3.77 | 2.15 | 644 |
| July 29 | do | 115 | 162 | 3.16 | 2.0 | 512 |
| September 21 | do | 80 | 102 | 2.25 | 1.62 | 230 |

*Daily gage height, in feet, of Rio Grande near San Ildefonso, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.31 | 2.4 | 3.88 | 3.62 | 7.85 | 9.3 | 4.05 | 3.25 | 1.6 | 2.1 | 1.9 | 2.3 |
| 2 | 2.36 | 2.45 | 4.38 | 3.72 | 8.45 | 9.1 | 3.85 | 2.65 | 1.6 | 1.9 | 1.9 | 2.3 |
| 3 | 2.36 | 2.55 | 4.33 | 3.77 | 8.95 | 9.2 | 3.65 | 3.1 | 1.6 | 1.9 | 1.9 | 2.2 |
| 4 | 2.26 | 2.8 | 4.48 | 3.72 | 8.75 | 9.5 | 3.5 | 2.8 | 1.6 | 1.8 | 2.0 | 2.2 |
| 5 | 2.26 | 2.55 | 4.98 | 3.57 | 7.6 | 10.2 | 3.25 | 2.7 | 1.9 | 1.8 | 2.0 | 2.2 |
| 6 | 2.26 | 2.55 | 4.78 | 3.62 | 7.4 | 10.5 | 3.05 | 2.8 | 2.0 | 1.8 | 2.0 | 2.2 |
| 7 | 2.26 | 2.4 | 4.88 | 3.77 | 7.3 | 10.45 | 2.85 | 3.0 | 1.9 | 1.8 | 2.2 | 2.2 |
| 8 | 2.36 | 2.45 | 4.93 | 4.22 | 6.65 | 10.7 | 2.65 | 2.9 | 1.8 | 1.8 | 2.0 | 2.2 |
| 9 | 2.36 | 2.45 | 4.58 | 4.42 | 7.6 | 11.1 | 2.5 | 2.6 | 1.8 | 1.8 | 1.9 | 2.2 |
| 10 | 2.46 | 2.4 | 4.38 | 4.87 | 7.45 | 10.4 | 2.45 | 2.4 | 1.8 | 1.8 | 1.9 | 2.2 |
| 11 | 2.36 | 2.49 | 4.38 | 4.96 | 6.8 | 10.05 | 2.25 | 2.6 | 1.8 | 1.8 | 1.9 | 2.2 |
| 12 | 2.46 | 2.49 | 4.43 | 4.96 | 7.05 | 9.65 | 2.2 | 2.5 | 1.7 | 1.8 | 2.2 | 2.3 |
| 13 | 2.36 | 2.24 | 4.08 | 5.16 | 7.2 | 9.4 | 2.05 | 2.4 | 1.7 | 1.8 | 2.2 | 2.3 |
| 14 | 2.16 | 2.19 | 4.18 | 5.06 | 7.4 | 9.05 | 2.0 | 2.3 | 1.7 | 1.8 | 2.2 | 2.3 |
| 15 | 2.06 | 2.24 | 4.73 | 4.91 | 8.2 | 8.45 | 2.0 | 2.2 | 1.7 | 1.7 | 2.2 | 2.3 |
| 16 | 2.31 | 2.54 | 4.63 | 4.86 | 8.8 | 8.15 | 1.9 | 2.0 | 1.7 | 1.7 | 2.2 | 2.3 |
| 17 | 2.31 | 2.49 | 4.58 | 4.96 | 9.65 | 7.7 | 1.85 | 1.9 | 1.7 | 1.7 | 2.2 | 2.3 |
| 18 | 2.46 | 2.44 | 4.48 | 5.06 | 10.5 | 7.5 | 1.8 | 1.8 | 1.6 | 1.7 | 2.2 | 2.3 |
| 19 | 2.36 | 2.44 | 4.08 | 5.36 | 11.1 | 7.15 | 1.8 | 1.6 | 1.6 | 1.7 | 2.2 | 2.2 |
| 20 | 2.36 | 2.49 | 4.03 | 5.46 | 11.6 | 6.85 | 1.85 | 1.5 | 1.6 | 1.7 | 2.2 | 2.2 |
| 21 | 2.35 | 2.54 | 4.17 | 5.31 | 11.5 | 6.45 | 2.1 | 1.3 | 1.6 | 1.7 | 2.2 | 2.2 |
| 22 | 2.4 | 2.54 | 4.17 | 6.01 | 11.45 | 6.3 | 2.2 | 1.0 | 1.6 | 1.7 | 3.0 | 2.3 |
| 23 | 2.35 | 2.59 | 4.02 | 6.01 | 11.5 | 5.95 | 2.2 | .6 | 1.6 | 1.9 | 3.0 | 2.3 |
| 24 | 2.35 | 2.79 | 3.92 | 6.31 | 11.75 | 5.7 | 2.1 | .6 | 1.6 | 1.9 | 2.5 | 2.3 |
| 25 | 2.4 | 3.04 | 3.82 | 5.36 | 11.8 | 5.45 | 2.2 | 2.0 | 1.8 | 1.9 | 2.4 | 2.3 |
| 26 | 2.35 | 3.49 | 3.87 | 5.41 | 11.5 | 5.15 | 2.2 | 1.8 | 2.0 | 1.9 | 2.4 | 2.1 |
| 27 | 2.3 | 3.64 | 4.12 | 5.61 | 11.25 | 4.9 | 2.05 | 1.8 | 2.1 | 1.9 | 2.3 | 1.9 |
| 28 | 2.3 | 3.69 | 4.17 | 6.26 | 10.9 | 4.75 | 2.2 | 1.7 | 1.9 | 1.9 | 2.3 | 1.9 |
| 29 | 2.35 | ....... | 3.77 | 6.81 | 10.6 | 4.45 | 2.1 | 1.6 | 1.8 | 1.9 | 2.4 | 1.9 |
| 30 | 2.4 | ....... | 3.67 | 7.31 | 10.5 | 4.25 | 2.75 | 1.6 | 1.8 | 1.9 | 2.3 | 1.9 |
| 31 | 2.4 | ....... | 3.57 | ....... | 9.4 | ....... | 3.45 | 1.6 | ....... | 1.9 | ....... | 1.9 |

*Station rating table for Rio Grande near San Ildefonso, N. Mex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 40 | 2.10 | 560 | 3.60 | 1,790 | 6.20 | 5,480 |
| 0.70 | 50 | 2.20 | 620 | 3.70 | 1,900 | 6.40 | 5,850 |
| 0.80 | 70 | 2.30 | 680 | 3.80 | 2,010 | 6.60 | 6,230 |
| 0.90 | 90 | 2.40 | 750 | 3.90 | 2,120 | 6.80 | 6,630 |
| 1.00 | 120 | 2.50 | 820 | 4.00 | 2,230 | 7.00 | 7,080 |
| 1.10 | 150 | 2.60 | 890 | 4.20 | 2,470 | 7.50 | 8,100 |
| 1.20 | 180 | 2.70 | 960 | 4.40 | 2,710 | 8.00 | 9,230 |
| 1.30 | 210 | 2.80 | 1,040 | 4.60 | 2,960 | 8.50 | 10,440 |
| 1.40 | 250 | 2.90 | 1,120 | 4.80 | 3,220 | 9.00 | 11,690 |
| 1.50 | 290 | 3.00 | 1,200 | 5.00 | 3,500 | 9.50 | 12,990 |
| 1.60 | 330 | 3.10 | 1,290 | 5.20 | 3,800 | 10.00 | 14,310 |
| 1.70 | 370 | 3.20 | 1,380 | 5.40 | 4,110 | 10.50 | 15,670 |
| 1.80 | 410 | 3.30 | 1,480 | 5.60 | 4,430 | 11.00 | 17,100 |
| 1.90 | 460 | 3.40 | 1,580 | 5.80 | 4,770 | 11.50 | 18,600 |
| 2.00 | 510 | 3.50 | 1,680 | 6.00 | 5,120 | | |

The above table is based on six discharge measurements made during 1905 and three high-water measurements made in 1903. It is not well defined.

*Estimated monthly discharge of Rio Grande near San Ildefonso, N. Mex., for 1905.*

[Drainage area, 14,050 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 792 | 540 | 707 | 43,470 | 0.050 | 0.058 |
| February | 1,889 | 614 | 929 | 51,590 | .066 | .069 |
| March | 3,472 | 1,757 | 2,571 | 158,100 | .183 | .211 |
| April | 7,682 | 1,757 | 3,679 | 218,900 | .262 | .292 |
| May | 19,500 | 6,330 | 12,770 | 785,200 | .909 | 1.05 |
| June | 17,400 | 2,530 | 9,625 | 572,700 | .685 | .764 |
| July | 2,290 | 410 | 874 | 53,740 | .062 | .072 |
| August | 1,430 | 40 | 629 | 38,680 | .045 | .052 |
| September | 560 | 330 | 389 | 23,150 | .028 | .031 |
| October | 560 | 370 | 422 | 25,950 | .030 | .035 |
| November | 1,200 | 460 | 638 | 37,960 | .045 | .050 |
| December | 680 | 460 | 617 | 37,940 | .044 | .051 |
| The year | 19,500 | 40 | 2,821 | 2,047,000 | .201 | 2.74 |

## RIO GRANDE NEAR SAN MARCIAL, N. MEX.

August 8, 1889, a station was established near San Marcial and a measurement was made which gave a discharge of 19 second-feet. Soon after this date, however, the river gage was destroyed and the locality was abandoned until January 29, 1895, when the station was reestablished by A. P. Davis at the bridge of the Atchison, Topeka and Santa Fe Railway, 1 mile south of San Marcial, N. Mex.

The channel is sandy and shifting. A number of bridge piers interfere with the current to a certain extent, but not with the observed gage heights. They sometimes affect the discharge measurements. There is no overflow channel beyond the bridge. The section gives gravity flow.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the bridge abutment on the left bank of the stream.

The inclined gage established January 29, 1895, was carried away in 1896 and a wire gage was put in its place. This gage has since been abandoned, and the gage heights are now measured with a graduated rod from the deck of the bridge, but using the old gage datum. The top of the ties on the bridge is at elevation 19.00 feet on the gage. The range between high and low water is about 8 feet. Bench marks were established as follows: (1) The top of the capstone on which the bridge truss rests; elevation, 15.00 feet. (2) The top of the extension of the pier to which the old vertical gage was fastened; elevation, 13.00 feet. Elevations refer to the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The various hydrographers at this station have also acted as gage readers.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Cross section: Ann 18, iv, p 257.
Description: Ann 18, iv, pp 254-255; Bull 131, p 46; 140, p 177; WS 16, p 131; 28, p 120; 37, p 282; 50, pp 351-352; 66, p 68; 84, pp 183-184; 99, pp 382-383; 132, pp 62-63.
Discharge: Ann 11, ii, p 107; 18, iv, p 256; Bull 131, p 46; 140, p 177; WS 16, p 131; 28, p 129; 37, p 283; 50, p 352; 66, pp 68-69; 84, pp 184-185; 99, pp 383-385; 132, pp 63-64, 127.
Discharge, mean daily: WS 132, p 66.
Discharge, monthly: Ann 18, iv, p 257; 19, iv, p 388; 20, iv, pp 358, 371; 21, iv, p 261; 22, iv, 352; WS 75, p 155; 84, p 186; 99, p 386; 132, p 67.
Discharge, yearly: Ann 20, iv, p 58.
Gage heights: Bull 140, p 178; WS 11, p 66; 16, p 131; 28, p 128; 37, p 283; 50, p 352; 66, p 69; 84, p 185; 99, p 386; 132, p 65.
Hydrographs: Ann 19, iv, p 389; 20, iv, p 371; 21, iv, p 261; 22, iv, p 352.
Rainfall and run-off relation: Ann 20, iv, p 359.
Rating tables: Ann 18, iv, p 256; 19, iv, p 387-388; WS 28, p 131.

*Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second* | *Feet.* | *Second-feet.* |
| January 3 | L. W. Broyles | 259 | 2.04 | 7.8 | 528 |
| January 6 | do | 325 | 2.10 | 8.0 | 684 |
| January 9 | do | 238 | 2.39 | 7.9 | 568 |
| January 12 | do | 297 | 3.10 | 8.1 | 922 |
| January 15 | do | 203 | 3.38 | 8.0 | 686 |
| January 18 | do | 184 | 2.95 | 7.9 | 543 |
| January 21 | do | 193 | 3.37 | 8.0 | 651 |
| January 24 | do | 176 | 3.05 | 7.9 | 536 |
| January 27 | do | 211 | 2.80 | 7.9 | 590 |
| January 31 | do | 197 | 3.43 | 8.0 | 675 |
| February 3 | do | 237 | 3.50 | 7.9 | 830 |
| February 6[a] | do | 184 | 3.59 | 7.9 | 661 |
| February 9 | do | 309 | 3.30 | 8.1 | 1,019 |
| February 12 | do | 258 | 2.98 | 8.0 | 768 |
| February 15 | do | 237 | 2.83 | 8.1 | 671 |
| February 18 | do | 284 | 2.93 | 8.0 | 831 |
| February 21 | do | 243 | 3.28 | 8.1 | 796 |
| February 24 | do | 246 | 3.01 | 8.0 | 740 |
| February 28 | do | 660 | 3.47 | 8.5 | 2,287 |
| March 3 | do | 720 | 4.01 | 8.6 | 2,886 |

[a] Ice in river.

*Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 5 | L. W. Broyles | 929 | 5.46 | 9.0 | 5,073 |
| March 8 | do | 979 | 4.70 | 8.9 | 4,598 |
| March 10 | do | 697 | 6.88 | 9.2 | 4,795 |
| March 12 | do | 664 | 5.04 | 8.6 | 3,344 |
| March 15 | do | 554 | 5.64 | 8.4 | 3,125 |
| March 18 | do | 833 | 4.57 | 9.3 | 3,806 |
| March 21 | do | 717 | 3.79 | 8.8 | 2,721 |
| March 24 | do | 731 | 4.07 | 9.0 | 2,972 |
| March 27 | do | 630 | 3.49 | 8.6 | 2,198 |
| March 31 | do | 652 | 4.18 | 8.7 | 2,724 |
| April 3 | do | 852 | 3.91 | 9.2 | 3,331 |
| April 6 | do | 589 | 3.07 | 8.5 | 1,808 |
| April 9 | do | 584 | 3.34 | 8.7 | 1,950 |
| April 12 | do | 972 | 4.02 | 9.6 | 3,911 |
| April 15 | do | 1,026 | 3.90 | 9.6 | 4,006 |
| April 18 | do | 954 | 4.03 | 9.1 | 3,840 |
| April 21 | do | 997 | 4.30 | 9.4 | 4,288 |
| April 24 | do | 1,769 | 5.50 | 10.2 | 9,726 |
| April 30 | do | 1,571 | 4.68 | 10.2 | 7,356 |
| May 3 | do | 1,558 | 5.03 | 10.7 | 7,829 |
| May 5 | do | 2,318 | 5.03 | 11.4 | 11,650 |
| May 7 | do | 1,833 | 5.98 | 10.7 | 10,955 |
| May 9 | do | 1,868 | 5.92 | 10.0 | 11,058 |
| May 11 | do | 1,597 | 5.44 | 10.3 | 8,694 |
| May 13 | do | 1,656 | 6.37 | 10.2 | 10,543 |
| May 15 | do | 1,684 | 6.15 | 10.3 | 10,361 |
| May 17 | do | 2,063 | 6.18 | 10.9 | 12,758 |
| May 19 | do | 2,474 | 6.51 | 11.6 | 16,097 |
| May 21 | do | 2,621 | 6.72 | 12.5 | 17,607 |
| May 23 | do | 4,093 | 6.55 | 12.8 | 26 810 |
| May 25 | do | 4,294 | 5.62 | 12.7 | 24,142 |
| May 28 | do | 4,642 | 5.51 | 13.2 | 25,577 |
| May 31 | do | 2,847 | 7.12 | 13.1 | 20,264 |
| June 3 | do | 3,154 | 6.33 | 11.9 | 19,973 |
| June 6 | do | 3,298 | 5.09 | 11.6 | 16,780 |
| June 9 | do | 2,821 | 5.34 | 12.7 | 15,071 |
| June 12 | do | 3,341 | 5.74 | 12.5 | 19,162 |
| June 15 | do | 2,660 | 4.40 | 10.9 | 11,702 |
| June 18 | do | 2,744 | 5.00 | 9.7 | 13,726 |
| June 21 | do | 1,976 | 4.55 | 9.4 | 9,000 |
| June 24 | do | 1,340 | 4.74 | 8.7 | 6,345 |
| June 26 | do | 983 | 4.34 | 8.4 | 4,271 |
| June 28 | do | 882 | 3.97 | 8.2 | 3,505 |
| June 30 | do | 722 | 3.66 | 8.0 | 2,641 |
| July 3 | do | 527 | 3.03 | 7.6 | 1,598 |
| July 6 | do | 359 | 3.18 | 7.4 | 1,143 |
| July 9 | do | 385 | 2.04 | 7.2 | 784 |
| July 12 | do | 209 | 2.23 | 6.8 | 466 |
| July 15 | do | 176 | 1.56 | 6.6 | 274 |
| July 18 | do | 141 | 1.33 | 6.4 | 188 |
| July 21 | do | 117 | 1.51 | 6.2 | 177 |
| July 24 | do | 108 | 1.46 | 6.3 | 158 |
| July 27 | do | 97 | 0.84 | 6.3 | 81 |
| July 31 | do | 35 | 1.91 | 5.9 | 67 |

*Discharge measurements of Rio Grande near San Marcial, N. Mex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 3 | L. W. Broyles | 334 | 2.56 | 7.4 | 854 |
| August 6 | do | 339 | 1.78 | 7.1 | 602 |
| August 9 | do | 334 | 1.91 | 7.3 | 637 |
| August 12 | do | 298 | 2.29 | 6.9 | 681 |
| August 15 | do | 207 | 2.15 | 6.5 | 446 |
| August 18 | do | 131 | 1.10 | 6.3 | 146 |
| August 21 | do | 80 | 1.20 | 6.0 | 94 |
| August 24 | do | 13 | 0.46 | 5.6 | 6 |
| September 7 | do | 117 | 2.74 | 7.3 | 321 |
| September 9 | do | 79 | 1.90 | 6.7 | 150 |
| September 11 | do | 61 | 1.52 | 6.5 | 93 |
| September 25 | do | 47 | 1.11 | 5.6 | 52 |
| September 27 | do | 144 | 1.60 | 6.7 | 231 |
| September 29 | do | 90 | 1.81 | 6.3 | 163 |
| October 5 | D. H. West | 92 | 1.71 | 5.9 | 157 |
| October 6 | do | 97 | 1.56 | 5.9 | 151 |
| October 8 | do | 74 | 1.69 | 5.8 | 125 |
| October 11 | do | 63 | 1.32 | 5.6 | 83 |
| October 14 | do | 70 | 1.39 | 5.7 | 97 |
| October 17 | do | 65 | 1.23 | 5.7 | 80 |
| October 20 | do | 68 | 1.24 | 5.7 | 84 |
| October 23 | do | 73 | 1.30 | 5.8 | 95 |
| October 26 | do | 84 | 1.50 | 5.9 | 126 |
| October 28 | do | 88 | 1.67 | 5.9 | 147 |
| October 31 | do | 101 | 1.71 | 6.2 | 173 |
| November 3 | do | 94 | 1.86 | 6.2 | 175 |
| November 9 | do | 255 | 2.90 | 7.1 | 740 |
| November 11 | do | 204 | 3.27 | 7.05 | 667 |
| November 14 | do | 232 | 2.51 | 7.0 | 582 |
| November 17 | do | 210 | 2.28 | 6.8 | 479 |
| November 20 | do | 196 | 2.45 | 6.8 | 481 |
| November 23 | do | 241 | 2.52 | 7.0 | 607 |
| November 25 | do | 548 | 2.96 | 7.6 | 1,624 |
| November 28 | do | 201 | 2.68 | 6.9 | 539 |
| November 30 | do | 446 | 3.42 | 7.7 | 1,527 |
| December 3 | Geo. W. King | 317 | 2.57 | 7.3 | 815 |
| December 6 | do | 249 | 2.14 | 7.2 | 533 |
| December 9 | do | 228 | 2.60 | 7.2 | 593 |
| December 12 | do | 220 | 2.74 | 7.2 | 603 |
| December 15 | do | 347 | 2.22 | 7.5 | 770 |
| December 18 | do | 275 | 2.26 | 7.3 | 621 |
| December 21 | do | 315 | 2.05 | 7.4 | 647 |
| December 24 | do | 127 | 1.81 | 6.9 | 230 |
| December 27 | do | 93 | 1.90 | 6.5 | 177 |
| December 30 | do | 105 | 1.77 | 6.5 | 186 |

*Daily gage height, in feet, of Rio Grande near San Marcial, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.7 | 8.0 | 8.8 | 8.85 | 10.35 | 12.6 | 8.05 | 6.75 | ....... | 6.4 | 6.1 | 7.7 |
| 2 | 7.7 | 7.9 | 8.75 | 8.9 | 10.5 | 12.2 | 7.75 | 6.9 | ....... | 6.15 | 6.1 | 7.4 |
| 3 | 7.8 | 7.9 | 8.65 | 9.1 | 10.65 | 11.95 | 7.6 | 7.15 | ....... | 6.1 | 6.2 | 7.3 |
| 4 | 7.95 | 8.0 | 9.1 | 8.85 | 11.25 | 11.5 | 7.5 | 7.15 | ....... | 6.0 | 6.35 | 7.2 |
| 5 | 8.0 | 8.0 | 9.05 | 8.65 | 11.5 | 11.45 | 7.45 | 7.0 | ....... | 5.95 | 6.45 | 7.2 |
| 6 | 7.95 | 8.05 | 8.95 | 8.5 | 11.45 | 11.55 | 7.4 | 7.15 | 6.8 | 5.95 | 6.5 | 7.15 |
| 7 | 7.8 | 8.65 | 8.9 | 8.4 | 10.7 | 11.9 | 7.35 | 7.0 | 7.3 | 5.9 | 6.65 | 7.25 |
| 8 | 7.9 | 8.45 | 8.95 | 8.5 | 10.15 | 12.3 | 7.3 | 7.05 | 6.7 | 5.8 | 6.9 | 7.25 |
| 9 | 7.9 | 8.15 | 9.25 | 8.75 | 9.9 | 12.7 | 7.2 | 7.4 | 6.7 | 5.7 | 7.05 | 7.15 |
| 10 | 8.05 | 7.95 | 9.25 | 9.05 | 10.1 | 12.55 | 7.05 | 7.2 | 6.85 | 5.6 | 6.75 | 7.3 |
| 11 | 8.15 | 7.9 | 8.85 | 9.45 | 10.3 | 12.5 | 6.9 | 7.0 | 6.5 | 5.6 | 7.05 | 7.3 |
| 12 | 8.1 | 8.0 | 8.6 | 9.65 | 10.45 | 12.35 | 6.8 | 6.95 | 6.1 | 5.7 | 7.0 | 7.2 |
| 13 | 8.1 | 7.8 | 8.8 | 9.95 | 10.1 | 11.9 | 6.8 | 6.8 | 5.4 | 5.7 | 6.9 | 7.3 |
| 14 | 8.05 | 7.65 | 8.75 | 9.65 | 10.3 | 11.3 | 6.7 | 6.75 | 5.3 | 5.7 | 6.95 | 7.3 |
| 15 | 8.0 | 8.0 | 8.6 | 9.55 | 10.25 | 11.0 | 6.6 | 6.55 | ....... | 5.75 | 6.9 | 7.45 |
| 16 | 8.0 | 7.9 | 8.65 | 9.7 | 10.65 | 10.4 | 6.6 | 6.45 | ....... | 5.7 | 6.8 | 7.5 |
| 17 | 8.05 | 8.0 | 8.95 | 9.2 | 10.85 | 10.05 | 6.5 | 6.4 | ....... | 5.7 | 6.8 | 7.4 |
| 18 | 7.9 | 8.0 | 9.2 | 9.1 | 11.1 | 9.7 | 6.4 | 6.3 | ....... | 5.7 | 6.8 | 7.3 |
| 19 | 7.9 | 8.1 | 9.15 | 9.15 | 11.45 | 9.3 | 6.3 | 6.2 | ....... | 5.7 | 6.8 | 7.4 |
| 20 | 7.8 | 8.25 | 9.15 | 9.3 | 11.85 | 9.4 | 6.2 | 6.1 | ....... | 5.7 | 6.8 | 7.4 |
| 21 | 8.0 | 8.15 | 8.8 | 9.4 | 12.35 | 9.35 | 6.2 | 6.0 | ....... | 5.7 | 6.8 | 7.4 |
| 22 | 8.0 | 8.05 | 8.7 | 9.5 | 12.75 | 9.0 | 6.1 | 5.85 | ....... | 5.8 | 6.9 | 7.25 |
| 23 | 7.95 | 7.95 | 8.75 | 9.7 | 12.95 | 8.8 | 6.2 | 5.7 | ....... | 5.8 | 7.0 | 7.2 |
| 24 | 7.9 | 8.0 | 9.0 | 10.3 | 13.05 | 8.7 | 6.35 | 5.6 | ....... | 5.75 | 8.65 | 6.9 |
| 25 | 7.9 | 8.8 | 8.9 | 11.0 | 12.65 | 8.55 | 6.2 | ....... | 5.6 | 5.8 | 7.75 | 6.5 |
| 26 | 7.9 | 8.6 | 8.75 | 10.45 | 13.15 | 8.35 | 6.4 | ....... | 7.55 | 5.9 | 7.6 | 6.4 |
| 27 | 7.9 | 8.45 | 8.6 | 10.15 | 13.2 | 8.2 | 6.25 | ....... | 7.3 | 5.9 | 7.3 | 6.5 |
| 28 | 7.9 | 8.55 | 8.6 | 9.95 | 13.2 | 8.2 | 6.1 | ....... | 6.2 | 5.95 | 6.95 | 6.5 |
| 29 | 7.95 | ....... | 8.7 | 10.0 | 13.15 | 8.1 | 6.1 | ....... | 6.7 | 6.05 | 6.95 | 6.5 |
| 30 | 8.0 | ....... | 8.8 | 10.2 | 13.0 | 8.0 | 6.0 | ....... | 6.55 | 6.05 | 7.7 | 6.5 |
| 31 | 8.0 | ....... | 8.7 | ....... | 13.0 | ....... | 5.9 | ....... | ....... | 6.15 | ....... | 6.5 |

NOTE.—No flow August 25 to September 5 and September 15–24

*Daily discharge in second-feet of Rio Grande near San Marcial, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 370 | 730 | 4,090 | 2,910 | 7,500 | 19,360 | 2,770 | 405 | 0 | 180 | 160 | 1,530 |
| 2 | 400 | 780 | 3,790 | 2,970 | 7,630 | 19,660 | 1,990 | 495 | 0 | 170 | 160 | 990 |
| 3 | [a] 530 | [a] 830 | [a] 3,190 | [a] 3,210 | [a] 7,790 | [a] 19,970 | [a] 1,600 | [a] 645 | 0 | 165 | [a] 175 | [a] 815 |
| 4 | 650 | 930 | 5,620 | 2,560 | 10,830 | 17,110 | 1,375 | 645 | 0 | 160 | 220 | 680 |
| 5 | 685 | 930 | [a] 5,350 | 2,120 | [a] 12,200 | 16,350 | 1,260 | 570 | 0 | [a] 160 | 260 | 610 |
| 6 | [a] 625 | [a] 970 | 4,840 | [a] 1,810 | 12,120 | [a] 16,480 | [a] 1,145 | [a] 645 | 180 | [a] 155 | 285 | [a] 505 |
| 7 | 470 | 2,760 | 4,600 | 1,730 | [a] 10,950 | 15,810 | 1,045 | 570 | [a] 320 | 150 | 375 | 585 |
| 8 | 570 | 2,130 | [a] 4,630 | 1,810 | 10,010 | 15,440 | 965 | 580 | 150 | [a] 125 | 550 | 605 |
| 9 | [a] 570 | [a] 1,180 | 4,830 | [a] 2,050 | [a] 10,560 | [a] 15,070 | [a] 785 | [a] 700 | [a] 150 | 105 | [a] 690 | [a] 565 |
| 10 | 830 | 720 | [a] 4,920 | 2,720 | 9,630 | 15,930 | 665 | 670 | 195 | 85 | 450 | 655 |
| 11 | 1,005 | 670 | 3,950 | 3,600 | [a] 8,690 | 17,390 | 545 | 645 | [a] 95 | [a] 85 | [a] 665 | 655 |
| 12 | [a] 920 | [a] 770 | [a] 3,340 | [a] 4,030 | 10,620 | [a] 18,460 | [a] 465 | [a] 710 | 50 | 95 | 580 | [a] 605 |
| 13 | 920 | 500 | 3,560 | 4,690 | [a] 10,040 | 16,370 | 465 | 620 | 10 | 95 | 510 | 660 |
| 14 | 800 | 290 | 3,500 | 4,090 | 10,700 | 13,570 | 370 | 590 | 5 | [a] 95 | [a] 550 | 660 |
| 15 | [a] 690 | [a] 570 | [a] 3,340 | [a] 3,900 | [a] 10,160 | [a] 12,170 | [a] 275 | [a] 470 | 0 | 95 | 530 | [a] 740 |
| 16 | 690 | 560 | 3,370 | 4,200 | 11,760 | 11,880 | 275 | 350 | 0 | 85 | 480 | 770 |
| 17 | 760 | 740 | 3,540 | 3,900 | [a] 12,560 | 12,800 | 230 | 255 | 0 | [a] 80 | [a] 480 | 695 |
| 18 | [a] 545 | [a] 830 | [a] 3,600 | [a] 3,840 | 13,710 | [a] 13,730 | [a] 190 | [a] 145 | 0 | 80 | 480 | [a] 620 |
| 19 | 545 | 880 | 3,490 | 3,910 | [a] 15,380 | 10,950 | 185 | 125 | 0 | 85 | 480 | 645 |
| 20 | 440 | 980 | 3,490 | 4,140 | 16,550 | 10,170 | 180 | 110 | 0 | [a] 85 | [a] 480 | 645 |
| 21 | [a] 650 | [a] 840 | [a] 2,720 | [a] 4,290 | [a] 17,350 | [a] 8,810 | [a] 175 | [a] 95 | 0 | 85 | 480 | [a] 645 |
| 22 | 650 | 770 | 2,600 | 4,840 | 23,400 | 7,480 | 170 | 60 | 0 | [a] 95 | 540 | 515 |
| 23 | 590 | 710 | 2,660 | 5,950 | [a] 28,600 | 6,720 | 165 | 25 | 0 | 95 | [a] 605 | 445 |
| 24 | [a] 535 | [a] 740 | [a] 2,970 | [a] 10,280 | 29,070 | [a] 6,340 | [a] 160 | [a] 5 | 0 | 90 | 3,720 | [a] 230 |
| 25 | 550 | 3,220 | 2,780 | 14,160 | [a] 23,540 | 5,300 | 120 | 0 | [a] 50 | 105 | [a] 1,920 | 175 |
| 26 | 570 | 2,600 | 2,490 | 9,210 | 28,000 | [a] 4,080 | 120 | 0 | 470 | [a] 125 | 1,620 | 160 |
| 27 | [a] 590 | 2,130 | [a] 2,200 | 7,210 | 27,100 | 3,500 | [a] 80 | 0 | [a] 400 | 135 | 1,160 | [a] 175 |
| 28 | 590 | [a] 2,440 | 2,280 | 6,610 | [a] 25,580 | [a] 3,500 | 70 | 0 | 145 | [a] 150 | [a] 620 | 180 |
| 29 | 630 | ....... | 2,560 | 6,760 | 23,600 | 3,070 | 70 | 0 | [a] 230 | 160 | 620 | 185 |
| 30 | 675 | ....... | 2,840 | [a] 7,360 | 20,430 | [a] 2,640 | 65 | 0 | 210 | 160 | [a] 1,530 | [a] 185 |
| 31 | [a] 675 | ....... | [a] 2,720 | ........ | [a] 19,060 | ........ | [a] 65 | 0 | ....... | [a] 170 | ....... | 185 |

[a] Meter measurements.

*Estimated monthly discharge of Rio Grande near San Marcial, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 1,005 | 370 | 636 | 39,114 |
| February | 3,220 | 290 | 1,150 | 63,868 |
| March | 5,620 | 2,200 | 3,544 | 217,904 |
| April | 14,160 | 1,730 | 4,695 | 279,392 |
| May | 29,070 | 7,500 | 15,649 | 962,221 |
| June | 19,970 | 2,640 | 12,004 | 714,268 |
| July | 2,770 | 65 | 582 | 35,782 |
| August | 710 | 0 | 327 | 20,093 |
| September | 470 | 0 | 89 | 5,276 |
| October | 180 | 80 | 120 | 7,349 |
| November | 3,720 | 160 | 713 | 42,397 |
| December | 1,530 | 160 | 559 | 34,344 |
| The year | 29,070 | 0 | 3,339 | 2,422,008 |

## RIO GRANDE NEAR EL PASO, TEX.

This station was located at the pumping house of the smelter company, 3 miles north of El Paso, Tex. The bed of the stream here is composed of mud, constantly shifting and changing. May 1, 1897, the station was placed under the charge of W. W. Follett, consulting engineer, International (Water) Boundary Commission, and by him removed 1 mile farther up the river to Courchesne's limekiln.

The left bank of the river is formed by the loose rock fill of the Atchison, Topeka and Santa Fe Railway embankment and will not overflow. The right bank is not so good, being made ground and subject to overflow. The bottom of the river here has also proved unstable, scouring on a rise and filling on a fall of the river. During the spring flood of 1905 the right bank began to erode and receded about 60 or 80 feet. This has left a bad low-water section. There is a large shifting bar about mid stream. It is still the best site for a station in the vicinity of El Paso, however, as the entire bed is constantly shifting for many miles above and below. On account of the shifting bed the only accurate method of estimating the daily discharge is by taking a large number of measurements. In extreme high water the bottom overflows slightly for a width of 200 feet beyond the right cable support.

Discharge measurements are made by means of a cable of 410 feet span, car, tagged wire, and guy wire. The initial point for soundings is the cable support on the left bank.

River heights were measured at the masonry pump-foundation pier. The pier was torn down in October, 1902, so an inclined wooden gage was established some 60 feet upstream. This is a timber bolted to steel bars set with cement in holes drilled in solid rock. The range between high and low water is about 11 feet. The bench mark is a one-half inch iron bolt set in solid rock at the head of the gage; elevation, 13.00 feet above the datum of the gage.

The observations at this station during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is W. L. Follett and the gage reader is Valmore Courchesne.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Cross section: Ann 18, iv, p 258.

Description: Ann 14, iv, p 114; 18, iv, pp 257-259; Bull 131, p 46; 140, p 178; WS 16, p 132; 28, p 120; 37, pp 283-284; 50, p 352; 66, p 70; 84, p 181; 99, pp 378-379; 132, pp 67-68.

Discharge: Ann 18, iv, p 259; Bull 140, p 179; WS 16, pp 132-133; 28, p 120; 37, p 284; 50, p 353; 66, p 70; 84, pp 181-182; 99, pp 379-381; 132, pp 68-69.

Discharge, mean daily: WS 132, p 70.

Discharge, monthly: Ann 11, ii, p 99; 12, ii, pp 350, 360; 13, iii, p 94; 14, iv, pp 114-115; 19, iv, p 390; 20 iv, pp 358, 372; 21, iv, p 262; 22, iv, p 353; WS 75, p 155; 84, p 183; 99, p 382; 132, p 71.

Discharge, yearly: Ann 11, ii, p 54; 13, iii, p 99; 20, iv, p 58.

Gage heights: Bull 131, p 47; 140, p 179; WS 11, p 67; 16, p 133; 28, p 128; 37, p 284; 50, p 353; 66, p 70; 84, p 182; 99, pp 381-382; 132, p 69.

*Hydrographs*: Ann 12, ii, p 280; 14, ii, p 114; 19, iv, p 390; 21, iv, p 263; 22, iv, p 353; WS 75, p 156.

*Rating tables*: Ann 19, iv, p 389; Bull 131, p 47.

*Sediment observations*: Ann 11, ii, p 57.

*Discharge measurements of Rio Grande near El Paso, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | Valmore Courchesne | 224 | 1.64 | 6.4 | 367 |
| January 8 | do | 228 | 1.68 | 6.3 | 384 |
| January 11 | do | 316 | 2.42 | 7.2 | 765 |
| January 14 | do | 395 | 2.57 | 7.6 | 1,014 |
| January 18 | do | 314 | 2.45 | 7.2 | 769 |
| January 21 | do | 267 | 2.34 | 7.0 | 625 |
| January 24 | do | 225 | 2.05 | 6.4 | 461 |
| January 28 | do | 226 | 2.38 | 6.7 | 538 |
| January 31 | do | 210 | 2.18 | 6.5 | 458 |
| February 3 | do | 222 | 2.20 | 6.6 | 488 |
| February 7 | do | 223 | 2.20 | 6.6 | 490 |
| February 10 | do | 268 | 2.49 | 7.0 | 668 |
| February 12 | do | 404 | 2.52 | 7.6 | 1,017 |
| February 15 | do | 274 | 2.14 | 6.8 | 587 |
| February 19 | do | 293 | 2.46 | 7.2 | 721 |
| February 21 | do | 464 | 2.71 | 8.0 | 1,258 |
| February 25 | do | 360 | 2.45 | 7.4 | 881 |
| February 28 | do | 438 | 3.11 | 8.15 | 1,364 |
| March 3 | do | 588 | 4.36 | 9.2 | 2,562 |
| March 8 | do | 861 | 4.21 | 9.9 | 3,625 |
| March 12 | do | 1,126 | 4.36 | 10.8 | 4,911 |
| March 15 | do | 670 | 5.14 | 9.8 | 3,445 |
| March 18 | do | 582 | 4.78 | 9.8 | 2,782 |
| March 21 | do | 801 | 3.96 | 10.3 | 3,170 |
| March 24 | do | 690 | 3.34 | 9.7 | 2,307 |
| March 31 | do | 629 | 2.69 | 9.3 | 1,694 |
| April 3 | do | 808 | 2.55 | 9.9 | 2,060 |
| April 6 | do | 737 | 3.01 | 9.9 | 2,222 |
| April 9 | do | 516 | 2.76 | 8.9 | 1,423 |
| April 14 | do | 798 | 3.67 | 10.35 | 2,932 |
| April 17 | do | 804 | 4.23 | 10.6 | 3,397 |
| April 20 | do | 757 | 3.92 | 10.3 | 2,971 |
| April 24 | do | 820 | 4.39 | 10.9 | 3,596 |
| April 29 | do | 1,295 | 5.42 | 12.75 | 7,014 |
| May 2 | do | 912 | 5.67 | 11.4 | 5,170 |
| May 6 | do | 1,253 | 5.18 | 12.5 | 6,490 |
| May 9 | do | 1,633 | 5.97 | 13.5 | 9,755 |
| May 12 | do | 1,063 | 5.50 | 11.5 | 5,847 |
| May 16 | do | 1,385 | 4.40 | 12.0 | 6,098 |
| May 20 | do | 1,201 | 5.05 | 12.3 | 6,065 |
| May 23 | do | 1,715 | 5.67 | 13.9 | 9,717 |
| May 25 | do | 1,870 | 5.27 | 14.6 | 9,859 |
| May 28 [a] | do | 3,722 | 4.51 | 15.6 | 16,795 |
| May 30 [a] | do | 4,094 | 4.62 | 15.9 | 18,924 |
| June 2 [a] | do | 3,806 | 5.44 | 16.1 | 20,722 |
| June 6 | do | 2,930 | 5.46 | 14.35 | 15,993 |
| June 9 | do | 2,738 | 6.43 | 14.8 | 17,609 |
| June 12 | do | 3,549 | 6.67 | 14.9 | 23,683 |
| June 15 | do | 3,607 | 6.54 | 14.9 | 23,591 |
| June 18 | do | 2,517 | 6.73 | 13.85 | 16,935 |
| June 21 | do | 1,162 | 6.29 | 12.4 | 7,312 |
| June 25 | do | 1,151 | 4.97 | 11.1 | 5,724 |
| June 27 | do | 1,080 | 4.23 | 10.5 | 4,565 |

[a] Includes overflow sections.

*Discharge measurements of Rio Grande near El Paso, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 30 | Valmore Courchesne | 1,031 | 3.30 | 9.5 | 3,398 |
| July 3 | do | 937 | 2.55 | 8.9 | 2,388 |
| July 7 | do | 669 | 2.07 | 8.1 | 1,383 |
| July 10 | do | 502 | 2.04 | 7.6 | 1,024 |
| July 13 | do | 363 | 1.91 | 7.4 | 694 |
| July 16 | do | 299 | 1.58 | 7.1 | 471 |
| July 19 | do | 239 | 1.74 | 6.8 | 415 |
| July 22 | do | 216 | 1.79 | 6.7 | 386 |
| July 25 | do | 263 | 1.65 | 6.8 | 435 |
| July 28 | do | 223 | 1.84 | 6.8 | 410 |
| July 31 | do | 174 | 1.50 | 6.5 | 261 |
| August 3 | do | 149 | 1.33 | 6.3 | 198 |
| August 7 | do | 369 | 1.97 | 7.3 | 726 |
| August 10 | do | 307 | 1.86 | 7.0 | 572 |
| August 12 | W. L. Follett | 481 | 2.04 | 7.7 | 979 |
| August 15 | W. W. Follett | 270 | 1.81 | 6.8 | 488 |
| August 18 | do | 197 | 1.52 | 6.4 | 300 |
| August 21 | do | 156 | 1.28 | 6.2 | 199 |
| August 24 | do | 123 | 1.19 | 6.0 | 146 |
| August 27 | do | 97 | 1.02 | 5.8 | 99 |
| August 30 | W. L. Follett | 75 | 0.75 | 5.6 | 56 |
| September 2 | do | 52 | 0.67 | 5.4 | 35 |
| September 5 | do | 34 | 0.91 | 5.4 | 31 |
| September 8 | do | 35 | 0.91 | 5.4 | 32 |
| September 11 | do | 33 | 0.82 | 5.3 | 27 |
| September 12 | do | 113 | 1.24 | 6.2 | 140 |
| September 14 | do | 88 | 1.27 | 5.9 | 112 |
| September 17 | do | 68 | 1.13 | 5.7 | 77 |
| September 20 | do | 32 | 1.47 | 5.5 | 47 |
| September 23 | do | 20 | 0.95 | 5.25 | 19 |
| September 26 | do | 16 | 1.00 | 5.2 | 16 |
| September 29 | do | 92 | 1.66 | 6.2 | 153 |
| October 2 | do | 113 | 1.76 | 6.45 | 199 |
| October 5 | do | 85 | 1.53 | 6.0 | 130 |
| October 8 | do | 72 | 1.25 | 5.8 | 90 |
| October 11 | do | 45 | 1.31 | 5.6 | 59 |
| October 14 | do | 38 | 1.16 | 5.5 | 44 |
| October 17 | do | 28 | 0.86 | 5.4 | 24 |
| October 20 | do | 23 | 1.00 | 5.3 | 23 |
| October 23 | do | 27 | 1.15 | 5.35 | 31 |
| October 26 | do | 30 | 1.30 | 5.4 | 39 |
| October 29 | do | 34 | 1.15 | 5.4 | 39 |
| November 1 | do | 35 | 1.03 | 5.5 | 36 |
| November 4 | do | 58 | 1.26 | 5.65 | 73 |
| November 7 | do | 83 | 1.37 | 5.85 | 114 |
| November 10 | do | 148 | 1.36 | 6.2 | 202 |
| November 15 | do | 216 | 1.83 | 6.75 | 395 |
| November 18 | do | 217 | 1.58 | 6.7 | 342 |
| November 21 | do | 208 | 1.49 | 6.6 | 309 |
| November 24 | do | 222 | 1.51 | 6.6 | 335 |
| November 27 | do | 569 | 2.51 | 8.05 | 1,426 |
| November 30 | do | 772 | 2.06 | 8.35 | 1,588 |
| December 3 | do | 659 | 2.05 | 8.2 | 1,349 |

*Discharge measurements of Rio Grande near El Paso, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| December 6 | W. L. Follett | 426 | 1.62 | 7.25 | 691 |
| December 9 | do | 374 | 1.45 | 6.9 | 541 |
| December 12 | do | 375 | 1.59 | 7.0 | 595 |
| December 15 | do | 352 | 1.63 | 7.0 | 572 |
| December 18 | do | 335 | 1.73 | 7.0 | 581 |
| December 21 | do | 334 | 1.65 | 6.95 | 550 |
| December 24 | do | 304 | 1.49 | 6.9 | 454 |
| December 27 | do | 300 | 1.62 | 6.9 | 486 |
| December 30 | do | 201 | 1.38 | 6.3 | 278 |

*Daily gage height, in feet, of Rio Grande near El Paso, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.4 | 6.5 | 9.05 | 9.6 | 11.55 | 16.05 | 9.35 | 6.5 | 5.45 | 6.65 | 5.5 | 7.75 |
| 2 | 6.4 | 6.55 | 9.2 | 9.9 | 11.4 | 16.1 | 9.15 | 6.4 | 5.4 | 6.4 | 5.6 | 7.65 |
| 3 | 6.4 | 6.55 | 9.15 | 9.85 | 11.6 | 15.95 | 8.9 | 6.35 | 5.4 | 6.25 | 5.6 | 8.2 |
| 4 | 6.3 | 6.5 | 9.4 | 9.65 | 11.7 | 15.4 | 8.7 | 6.3 | 5.4 | 6.1 | 5.65 | 7.9 |
| 5 | 6.25 | 6.5 | 9.7 | 9.7 | 12.15 | 14.95 | 8.6 | 6.3 | 5.4 | 6.0 | 5.7 | 7.55 |
| 6 | 6.25 | 6.5 | 9.6 | 9.9 | 12.45 | 14.25 | 8.45 | 6.4 | 5.4 | 6.0 | 5.7 | 7.25 |
| 7 | 6.3 | 6.6 | 9.95 | 9.6 | 12.9 | 13.85 | 8.2 | 7.3 | 5.4 | 5.9 | 5.85 | 7.1 |
| 8 | 6.3 | 6.6 | 9.95 | 9.25 | 13.3 | 13.85 | 8.05 | 7.15 | 5.4 | 5.8 | 6.0 | 7.0 |
| 9 | 6.3 | 6.7 | 10.1 | 8.9 | 13.5 | 14.75 | 7.85 | 6.95 | 5.4 | 5.8 | 6.05 | 6.9 |
| 10 | 6.85 | 7.25 | 10.8 | 8.85 | 12.9 | 14.5 | 7.65 | 7.05 | 5.3 | 5.65 | 6.2 | 6.8 |
| 11 | 7.2 | 8.05 | 10.8 | 9.0 | 11.75 | 14.5 | 7.6 | 7.0 | 5.3 | 5.6 | 6.3 | 6.85 |
| 12 | 7.2 | 7.65 | 10.8 | 9.2 | 11.5 | 14.9 | 7.6 | 7.65 | 5.9 | 5.6 | 6.35 | 7.0 |
| 13 | 8.05 | 7.3 | 10.4 | 9.75 | 11.65 | 14.75 | 7.45 | 7.4 | 5.95 | 5.55 | 6.65 | 7.05 |
| 14 | 7.7 | 7.0 | 10.05 | 10.35 | 12.05 | 14.9 | 7.3 | 6.95 | 5.9 | 5.5 | 6.7 | 7.05 |
| 15 | 7.5 | 6.8 | 9.9 | 10.8 | 12.2 | 14.85 | 7.2 | 6.8 | 5.9 | 5.45 | 6.7 | 7.0 |
| 16 | 7.4 | 6.8 | 9.9 | 10.85 | 12.05 | 14.85 | 7.1 | 6.65 | 5.8 | 5.4 | 6.7 | 7.0 |
| 17 | 7.3 | 6.7 | 9.9 | 10.6 | 11.9 | 14.35 | 7.0 | 6.5 | 5.7 | 5.4 | 6.7 | 7.1 |
| 18 | 7.2 | 6.45 | 9.7 | 10.6 | 12.05 | 13.9 | 6.9 | 6.4 | 5.6 | 5.4 | 6.7 | 7.0 |
| 19 | 7.0 | 7.2 | 9.7 | 10.55 | 12.2 | 13.35 | 6.8 | 6.3 | 5.55 | 5.4 | 6.6 | 7.15 |
| 20 | 7.0 | 8.05 | 10.1 | 10.35 | 12.35 | 12.8 | 6.75 | 6.2 | 5.5 | 5.3 | 6.6 | 7.05 |
| 21 | 6.95 | 7.95 | 10.3 | 10.3 | 12.7 | 12.4 | 6.7 | 6.2 | 5.4 | 5.3 | 6.6 | 7.0 |
| 22 | 6.7 | 7.6 | 10.3 | 10.3 | 13.3 | 12.0 | 6.7 | 6.05 | 5.35 | 5.3 | 6.55 | 6.95 |
| 23 | 6.6 | 7.75 | 10.05 | 10.7 | 13.9 | 11.85 | 6.9 | 6.0 | 5.25 | 5.3 | 6.55 | 6.85 |
| 24 | 6.4 | 7.65 | 9.75 | 11.0 | 14.3 | 11.4 | 6.95 | 6.0 | 5.2 | 5.4 | 6.6 | 6.9 |
| 25 | 6.4 | 7.45 | 9.55 | 11.35 | 14.65 | 11.1 | 6.8 | 5.95 | 5.2 | 5.4 | 6.8 | 6.95 |
| 26 | 6.55 | 7.5 | 9.55 | 12.15 | 15.0 | 10.7 | 6.65 | 5.8 | 5.2 | 5.4 | 6.9 | 6.9 |
| 27 | 6.75 | 7.65 | 9.75 | 13.0 | 15.3 | 10.5 | 6.6 | 5.8 | 5.2 | 5.4 | 7.8 | 6.8 |
| 28 | 6.7 | 8.05 | 9.6 | 13.1 | 15.55 | 10.15 | 6.7 | 5.75 | 5.8 | 5.4 | 8.25 | 6.55 |
| 29 | 6.6 | ....... | 9.45 | 12.9 | 15.75 | 9.9 | 6.8 | 5.6 | 6.25 | 5.4 | 8.75 | 6.3 |
| 30 | 6.5 | ....... | 9.3 | 12.15 | 15.9 | 9.6 | 6.55 | 5.55 | 6.05 | 5.45 | 8.3 | 6.3 |
| 31 | 6.5 | ....... | 9.3 | ....... | 15.9 | ....... | 6.5 | 5.5 | ....... | 5.5 | ....... | 6.2 |

*Daily discharge, in second-feet, of Rio Grande near El Paso, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 405 | 460 | 2,390 | 1,880 | 5,380 | 20,270 | 3,150 | 260 | 40 | 230 | [a]35 | 1,035 |
| 2 | 385 | 475 | 2,560 | 2,060 | [a]5,170 | [a]20,720 | 2,810 | 230 | [a]35 | [a]195 | 60 | 965 |
| 3 | [a]365 | [a]475 | [a]2,500 | [a]2,030 | 5,410 | 20,320 | [a]2,390 | [a]215 | 35 | 170 | 60 | [a]1,350 |
| 4 | 340 | 460 | 2,860 | 1,960 | 5,530 | 18,840 | 2,130 | 200 | 30 | 145 | [a]75 | 1,140 |
| 5 | 330 | 460 | 3,320 | 2,040 | 6,070 | 17,620 | 2,000 | 200 | [a]30 | [a]130 | 85 | 895 |
| 6 | 340 | 460 | 3,170 | [a]2,220 | [a]6,430 | [a]15,630 | 1,820 | 250 | 30 | 130 | 85 | [a]690 |
| 7 | 370 | [a]490 | 3,700 | 1,980 | 7,800 | 14,190 | [a]1,510 | [a]725 | 30 | 110 | [a]115 | 625 |
| 8 | [a]385 | 490 | [a]3,700 | 1,700 | 9,100 | 14,190 | 1,350 | 645 | [a]35 | [a]90 | 150 | 585 |
| 9 | 385 | 550 | 3,910 | [a]1,420 | [a]9,760 | [a]17,410 | 1,200 | 545 | 30 | 90 | 165 | [a]540 |
| 10 | 620 | [a]820 | 4,910 | 1,370 | 8,590 | 18,300 | [a]1,060 | [a]595 | 30 | 65 | [a]200 | 500 |
| 11 | [a]765 | 1,290 | 4,910 | 1,530 | 6,350 | 20,190 | 970 | 570 | [a]25 | [a]60 | 235 | 525 |
| 12 | 765 | [a]1,050 | [a]4,910 | 1,740 | [a]5,850 | [a]23,680 | 910 | [a]950 | [a]110 | 60 | 255 | [a]595 |
| 13 | 1,290 | 860 | 4,330 | 2,310 | 5,960 | 23,050 | [a]735 | 810 | 115 | 50 | 360 | 620 |
| 14 | [a]1,075 | 695 | 3,810 | [a]2,930 | 6,570 | 23,620 | 620 | 565 | [a]110 | [a]45 | 380 | 620 |
| 15 | 950 | [a]585 | [a]3,590 | 3,760 | 6,680 | [a]23,270 | 545 | [a]490 | 110 | 35 | [a]380 | [a]570 |
| 16 | 890 | 585 | 3,370 | 3,850 | [a]6,200 | 23,270 | [a]470 | 415 | 90 | 25 | 370 | 575 |
| 17 | 830 | 550 | 3,150 | [a]3,400 | 5,740 | 20,100 | 450 | 345 | [a]75 | [a]25 | 355 | 630 |
| 18 | [a]770 | 460 | [a]2,700 | 3,400 | 5,880 | [a]17,250 | 430 | [a]300 | 60 | 25 | [a]340 | [a]580 |
| 19 | 630 | [a]720 | 2,700 | 3,330 | 6,020 | 13,620 | [a]415 | 250 | 50 | 25 | 310 | 655 |
| 20 | 625 | 1,290 | 3,020 | [a]3,040 | [a]6,180 | 9,970 | 400 | 200 | [a]45 | [a]25 | 310 | 605 |
| 21 | [a]605 | [a]1,220 | [a]3,170 | 2,970 | 6,980 | [a]7,310 | 385 | [a]200 | 35 | 25 | [a]310 | [a]580 |
| 22 | 540 | 1,000 | 3,170 | 2,970 | 8,360 | 6,820 | [a]385 | 160 | 30 | 25 | 305 | 530 |
| 23 | 515 | 1,100 | 2,810 | 3,380 | [a]9,720 | 6,640 | 485 | 145 | [a]20 | [a]30 | 315 | 455 |
| 24 | [a]460 | 1,035 | [a]2,380 | [a]3,780 | 9,800 | 6,090 | 510 | [a]145 | 15 | 40 | [a]335 | [a]455 |
| 25 | 460 | [a]910 | 2,080 | 4,430 | [a]10,210 | [a]5,720 | [a]435 | 130 | 15 | 40 | 485 | 480 |
| 26 | 500 | 975 | 2,080 | 5,900 | 12,640 | 4,950 | 385 | 100 | [a]15 | [a]40 | 560 | 475 |
| 27 | 555 | 1,070 | 2,380 | 7,500 | 14,720 | [a]4,560 | 360 | [a]100 | 15 | 40 | [a]1,240 | [a]450 |
| 28 | [a]540 | [a]1,300 | 2,150 | 7,700 | [a]16,450 | 4,150 | [a]380 | 85 | 110 | 40 | 1,530 | 365 |
| 29 | 500 | ....... | 1,920 | [a]7,300 | 17,860 | 3,860 | 410 | 55 | [a]165 | [a]40 | 1,870 | 280 |
| 30 | 460 | ....... | 1,690 | 5,900 | 18,920 | [a]3,510 | 285 | [a]50 | 140 | 40 | [a]1,560 | [a]280 |
| 31 | [a]460 | ....... | [a]1,690 | ....... | [a]18,920 | ....... | [a]260 | 45 | ....... | 40 | ....... | 245 |

[a] Meter measurements.

*Estimated monthly discharge of Rio Grande near El Paso, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 1,290 | 330 | 584 | 35,920 |
| February | 1,300 | 460 | 780 | 43,309 |
| March | 4,910 | 1,690 | 3,065 | 188,489 |
| April | 7,700 | 1,370 | 3,326 | 197,911 |
| May | 18,920 | 5,170 | 8,879 | 545,950 |
| June | 23,680 | 3,510 | 14,304 | 851,147 |
| July | 3,150 | 260 | 956 | 58,800 |
| August | 950 | 45 | 322 | 19,785 |
| September | 165 | 15 | 56 | 3,322 |
| October | 230 | 25 | 69 | 4,225 |
| November | 1,870 | 35 | 428 | 25,458 |
| December | 1,350 | 245 | 610 | 37,478 |
| The year | 23,680 | 15 | 2,782 | 2,011,794 |

## RIO GRANDE ABOVE PRESIDIO, TEX.

This station was established April 4, 1900, by the International (Water) Boundary Commission. It was 9 miles above Presidio and above the mouth of Rio Conchos, one of the principal tributaries of the Rio Grande, and about 200 miles below El Paso. The station was in a straight stretch of the river, but in the bight of a long bend. In 1903 the river began to erode a cut-off across this bend and the spring flood of 1905 deepened this channel to such an extent that more water passed through it than through the station, and it became necessary to abandon its location. In September, 1905, the station was moved 8 miles farther upstream and rebuilt. Its location is far enough above the mouth of Rio Conchos to be free from the effects of backwater from that stream.

The river is nearly straight for one-fourth mile above and below the new location. Both banks overflow slightly in extreme flood, but no large amount of water passes outside the measured section. The bed is shifting sand. The banks are fairly solid, but would erode if a heavy current should strike them.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling fastened to posts sunk in the ground. The bottom of the river was gage height 1.5 feet September 21, 1905, and marks showed high water to be 9.5 feet. The bench mark is the top of a mesquite post level with the ground back of the left guy-cable deadman; elevation, 9.35 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer was Jas. P. Hague, and the gage reader was Preciliano Spencer.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 355; 66, p 72; 84, p 177; 99, p 373; 132, p 71.
Discharge: WS 50, p 355; 66, pp 72-73; 84, p 178; 99, pp 373-375; 132, p 72.
Discharge, mean daily: WS 132, p 74.
Discharge, monthly: Ann 22, iv, p 354; WS 75, p 157; 84, p 179; 99, p 376; 132, p 75.
Gage heights: WS 50, p 355; 66, p 73; 84, p 178; 99, pp 375-376; 132, p 73.

*Discharge measurements of Rio Grande above Presidio, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | Jas. P. Hague | 158 | 2.04 | 3.55 | 323 |
| January 6 | do | 145 | 2.03 | 3.4 | 295 |
| January 9 | do | 143 | 1.96 | 3.4 | 280 |
| January 12 | do | 140 | 1.91 | 3.3 | 267 |
| January 15 | do | 167 | 2.07 | 3.6 | 346 |
| January 18 | do | 213 | 2.98 | 4.2 | 634 |
| January 21 | do | 205 | 2.70 | 3.95 | 554 |
| January 24 | do | 186 | 2.52 | 3.8 | 469 |
| January 27 | do | 171 | 2.29 | 3.7 | 392 |
| January 30 | do | 163 | 2.28 | 3.55 | 371 |
| February 2 | do | 169 | 2.09 | 3.55 | 354 |
| February 5 | do | 171 | 2.35 | 3.7 | 401 |
| February 8 | do | 155 | 2.06 | 3.5 | 320 |
| February 11 | do | 159 | 2.13 | 3.5+ | 335 |
| February 14 | do | 163 | 2.12 | 3.55 | 349 |
| February 17 | do | 200 | 2.71 | 3.9 | 541 |
| February 20 | do | 161 | 2.37 | 3.6 | 381 |
| June 17[a] | do | 1,489 | 4.10 | 8.8 | 6,109 |
| June 21[a] | do | 1,353 | 3.61 | 8.6 | 4,888 |

[a] Channel only. Bottoms overflowed. The channel was carrying less than 50 per cent of the total discharge at the station. The actual discharge was computed from daily gage heights, the flow of lower Presido station, and of Conchos River.

*Discharge measurements of Rio Grande above Presidio, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 24[a] | Jas. P. Hague | 1,322 | 3.34 | 8.5 | 4,411 |
| June 27[a] | do | 1,301 | 3.33 | 8.5 | 4,331 |
| July 1[a] | do | 1,269 | 2.97 | 8.2 | 3,771 |
| July 5[a] | do | 1,097 | 2.43 | 7.0 | 2,668 |
| July 8[a] | do | 917 | 1.93 | 6.2 | 1,774 |
| July 11 | do | 671 | 2.13 | 5.0 | 1,432 |
| July 14 | do | 422 | 2.91 | 4.2 | 1,226 |
| July 17 | do | 526 | 3.48 | 5.6 | 1,830 |
| July 19[b] | do | 633 | 3.61 | 6.05 | 2,285 |
| July 21 | do | 507 | 3.58 | 5.5 | 1,814 |
| July 24 | do | 456 | 3.37 | 5.2 | 1,537 |
| July 27 | do | 295 | 3.16 | 3.65 | 932 |
| July 30 | do | 290 | 3.14 | 3.6 | 912 |
| August 2 | do | 338 | 2.67 | 3.7 | 903 |
| August 5 | do | 333 | 2.79 | 3.7 | 929 |
| August 8 | do | 232 | 2.02 | 2.6 | 469 |
| August 10 | do | 235 | 2.36 | 2.7 | 555 |
| August 13 | do | 223 | 1.87 | 2.6 | 416 |
| August 16 | do | 259 | 2.12 | 3.0 | 549 |
| August 19 | do | 265 | 2.13 | 3.0 | 565 |
| August 22 | do | 260 | 2.03 | 2.8 | 528 |
| August 25 | do | 225 | 1.89 | 2.4 | 426 |
| August 27 | do | 201 | 1.61 | 2.15 | 323 |
| August 30 | do | 213 | 1.59 | 2.2 | 339 |
| September 2 | do | 127 | 1.57 | 1.8 | 200 |
| September 5 | do | 171 | 1.77 | 2.3 | 302 |
| September 7 | do | 419 | 4.09 | 5.4 | 1,712 |
| September 10 | do | 282 | 2.20 | 3.15 | 620 |
| September 13 | do | 277 | 2.13 | 3.0 | 590 |
| September 16 | do | 70 | 1.51 | 1.5 | 106 |
| September 18 | do | 80 | 1.69 | 1.5 | 135 |
| September 21 | do | 71 | 1.56 | 1.5 | 111 |
| September 26[c] | do | 75 | 1.57 | 3.0 | 118 |
| September 29 | do | 65 | 1.66 | 2.9 | 108 |
| October 2 | do | 63 | 1.52 | 2.75 | 96 |
| October 5 | do | 54 | 1.44 | 2.7 | 78 |
| October 8 | do | 63 | 1.41 | 2.7 | 89 |
| October 11 | do | 66 | 1.39 | 2.7 | 92 |
| October 14 | do | 53 | 1.38 | 2.7 | 73 |
| October 17 | do | 56 | 1.30 | 2.7 | 73 |
| October 20 | do | 62 | 1.29 | 2.7 | 80 |
| October 23 | do | 58 | 1.31 | 2.7 | 76 |
| October 29 | do | 45 | 1.16 | 2.6 | 52 |
| November 1 | do | 46 | 1.11 | 2.6 | 51 |
| November 5 | do | 33 | 1.09 | 2.5 | 36 |
| November 8 | do | 48 | 1.23 | 2.65 | 59 |
| November 11 | do | 136 | 1.66 | 3.4 | 226 |
| November 14 | do | 164 | 1.59 | 3.5 | 260 |

[a] Channel only. Bottoms overflowed. The channel was carrying less than 50 per cent of the total discharge at the station. The actual discharge was computed from daily gage heights, the flow of lower Presidio station, and of Conchos River.

[b] Channel only. Bottoms overflowed. Overflow ceased at 5.5 feet on gage

[c] Station moved 8 miles farther up Rio Grande and new gage established 16 miles above mouth of Conchos. The new gage heights are not comparable with old.

**Note.—No measurements were made during March, April, and May.**

*Discharge measurements of the Rio Grande above Presidio, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| November 17 | Jas. P. Hague | 135 | 1.72 | 3.4 | 232 |
| November 20 | do | 109 | 1.31 | 3.1 | 143 |
| November 23 | do | 101 | 1.29 | 3.0 | 130 |
| November 26 | do | 98 | 1.31 | 3.0 | 128 |
| November 29 | do | 90 | 1.29 | 2.9 | 116 |
| December 3 | do | 213 | 2.07 | 3.8 | 441 |
| December 6 | do | 320 | 2.54 | 4.4 | 813 |
| December 9 | do | 291 | 2.50 | 4.3 | 728 |
| December 12 | do | 328 | 2.67 | 4.4 | 875 |
| December 16 | do | 227 | 2.52 | 4.0 | 571 |
| December 19 | do | 204 | 2.34 | 3.8 | 478 |
| December 22 | do | 251 | 2.31 | 4.2 | 581 |
| December 24 | do | 228 | 2.49 | 4.15 | 567 |
| December 28 | do | 216 | 2.55 | 4.15 | 551 |
| December 31 | do | 192 | 2.57 | 4.0 | 494 |

*Daily gage height, in feet, of Rio Grande above Presidio, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 3.45 | 4.05 | 6.25 | 7.8 | 7.85 | 8.15 | 3.3 | 1.7 | 2.8 | 2.6 | 3.2 |
| 2 | 3.7 | 3.55 | 4.35 | 6.0 | 7.85 | 8.0 | 7.9 | 3.95 | 1.65 | 2.75 | 2.6 | 3.4 |
| 3 | 3.55 | 3.5 | 4.75 | 5.75 | 8.0 | 8.1 | 7.6 | 2.85 | 2.0 | 2.7 | 2.6 | 3.8 |
| 4 | 3.5 | 3.5 | 4.5 | 5.95 | 8.0 | 8.2 | 7.3 | 3.25 | 2.1 | 2.7 | 2.5 | 4.3 |
| 5 | 3.4 | 3.65 | 5.8 | 6.3 | 7.9 | 8.25 | 6.8 | 3.6 | 2.45 | 2.7 | 2.55 | 4.4 |
| 6 | 3.4 | 3.7 | 6.3 | 6.45 | 8.1 | 8.5 | 6.6 | 2.9 | 1.7 | 2.7 | 2.6 | 4.4 |
| 7 | 3.4 | 3.65 | 6.6 | 6.25 | 8.1 | 8.6 | 6.45 | 2.85 | 5.95 | 2.7 | 2.6 | 4.45 |
| 8 | 3.4 | 3.55 | 7.45 | 6.2 | 8.1 | 8.75 | 6.15 | 2.7 | 4.15 | 2.7 | 2.65 | 4.3 |
| 9 | 3.4 | 3.5 | 7.25 | 6.1 | 7.9 | 8.8 | 5.75 | 2.85 | 5.6 | 2.7 | 3.55 | 4.3 |
| 10 | 3.4 | 3.55 | 7.4 | 6.25 | 7.75 | 8.85 | 5.3 | 2.65 | 3.15 | 2.7 | 3.5 | 4.2 |
| 11 | 3.4 | 3.55 | 7.8 | 5.85 | 7.65 | 8.9 | 4.95 | 2.55 | 2.8 | 2.7 | 3.4 | 4.25 |
| 12 | 3.3 | 3.4 | 7.9 | 5.5 | 7.7 | 8.85 | 4.7 | 2.6 | 3.05 | 2.7 | 3.6 | 4.35 |
| 13 | 3.3 | 3.5 | 8.0 | 5.3 | 8.0 | 9.05 | 4.5 | 2.9 | 2.95 | 2.7 | 3.55 | 4.1 |
| 14 | 3.3 | 3.6 | 8.15 | 5.0 | 8.0 | 9.05 | 4.15 | 2.6 | 2.25 | 2.7 | 3.45 | 4.0 |
| 15 | 3.45 | 3.55 | 8.2 | 4.9 | 8.1 | 8.8 | 7.65 | 2.6 | 1.7 | 2.7 | 3.75 | 4.05 |
| 16 | 3.6 | 3.8 | 8.0 | 5.15 | 8.05 | 8.75 | 5.8 | 2.9 | 1.55 | 2.7 | 3.65 | 3.95 |
| 17 | 3.95 | 3.9 | 8.2 | 5.6 | 8.2 | 8.8 | 6.7 | 3.9 | 1.65 | 2.7 | 3.45 | 3.8 |
| 18 | 4.25 | 4.0 | 7.95 | 6.15 | 8.15 | 8.5 | 4.75 | 3.35 | 1.5 | 2.7 | 3.5 | 3.85 |
| 19 | 4.15 | 3.75 | 7.85 | 6.9 | 8.2 | 8.75 | 6.45 | 2.95 | 2.15 | 2.7 | 3.4 | 3.8 |
| 20 | 4.0 | 3.6 | 7.8 | 7.65 | 8.25 | 8.7 | 8.05 | 3.1 | 1.65 | 2.7 | 3.15 | 4.15 |
| 21 | 3.95 | 3.7 | 7.55 | 7.6 | 7.65 | 8.65 | 5.2 | 2.8 | 1.5 | 2.7 | 3.1 | 4.25 |
| 22 | 3.9 | 3.6 | 7.3 | 7.75 | 7.8 | 8.8 | 4.0 | 2.7 | 1.4 | 2.7 | 3.1 | 4.2 |
| 23 | 3.8 | 3.55 | 7.45 | 7.7 | 7.65 | 8.65 | 4.85 | 2.6 | 1.2 | 2.7 | 3.0 | 4.2 |
| 24 | 3.8 | 3.4 | 7.65 | 7.45 | 7.5 | 8.55 | 5.5 | 2.35 | 1.2 | 2.7 | 3.0 | 4.15 |
| 25 | 3.75 | 4.25 | 7.65 | 7.4 | 7.5 | 8.5 | 6.55 | 2.25 | 1.2 | 2.6 | 3.0 | 4.15 |
| 26 | 3.7 | 4.25 | 7.55 | 7.4 | 7.5 | 8.45 | 4.45 | 2.0 | [a] 3.0 | 2.6 | 3.0 | 4.2 |
| 27 | 3.75 | 4.15 | 7.2 | 7.75 | 7.55 | 7.95 | 3.65 | 2.15 | 3.0 | 2.6 | 3.0 | 4.25 |
| 28 | 3.6 | 4.1 | 6.7 | 7.85 | 7.6 | 7.7 | 3.65 | 1.8 | 2.9 | 2.6 | 3.0 | 4.15 |
| 29 | 3.6 | | 6.4 | 8.0 | 7.5 | 7.55 | 3.6 | 1.9 | 2.9 | 2.6 | 2.95 | 4.1 |
| 30 | 3.55 | | 6.35 | 7.85 | 7.6 | 7.8 | 3.6 | 2.35 | 2.8 | 2.6 | 2.9 | 4.05 |
| 31 | 3.5 | | 6.3 | | 7.75 | | 3.6 | 1.85 | | 2.6 | | 4.0 |

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[a] September 26 this station was moved 8 miles farther up the Rio Grande and a new gage was established. The new gage heights are not comparable with the old.

*Daily discharge, in second-feet, of Rio Grande above Presidio, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar.[a] | Apr.[b] | May.[c] | June.[d] | July.[e] | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 355 | 330 | 580 | 1,580 | 2,750 | 5,850 | [f]6,400 | 740 | 180 | 100 | [f]50 | 225 |
| 2 | 355 | [f]355 | 650 | 1,470 | 2,850 | 6,200 | 5,400 | [f]1,000 | [f]170 | [f]95 | 50 | 295 |
| 3 | [f]325 | 340 | 800 | 1,370 | 3,100 | 6,500 | 4,200 | 575 | 240 | 85 | 50 | [f]440 |
| 4 | 315 | 340 | 700 | 1,510 | 3,200 | 6,900 | 3,600 | 745 | 260 | 80 | 35 | 755 |
| 5 | 295 | [f]385 | 1,310 | 1,730 | 3,200 | 7,480 | [f]2,970 | [f]890 | [f]330 | [f]80 | [f]40 | 815 |
| 6 | [f]295 | 400 | 1,580 | 1,850 | 3,500 | 8,860 | 2,730 | 595 | 180 | 80 | 50 | [f]815 |
| 7 | 290 | 380 | 1,760 | 1,730 | 3,600 | 9,640 | 2,580 | 575 | [f]2,260 | 85 | 50 | 855 |
| 8 | 285 | [f]340 | 2,310 | 1,700 | 3,700 | 10,620 | [f]2,280 | [f]510 | 1,070 | [f]90 | [f]60 | 730 |
| 9 | [f]280 | 325 | 2,180 | 1,640 | 3,600 | 11,200 | 1,880 | 595 | 1,910 | 90 | 270 | [f]730 |
| 10 | 280 | 345 | 2,270 | 1,730 | 3,550 | 11,780 | 1,610 | [f]535 | [f]620 | 90 | 255 | 670 |
| 11 | 280 | [f]350 | 2,810 | 1,510 | 3,550 | 12,360 | [f]1,420 | 460 | 550 | [f]90 | [f]225 | 735 |
| 12 | [f]265 | 315 | 2,960 | 1,340 | 3,700 | 12,540 | 1,350 | 445 | 600 | 85 | 295 | [f]835 |
| 13 | 265 | 335 | 3,110 | 1,240 | 4,100 | 13,700 | 1,300 | [f]515 | [f]575 | 80 | 280 | 645 |
| 14 | 265 | [f]360 | 3,330 | 1,090 | 4,200 | 13,700 | [f]1,210 | 415 | 350 | [f]75 | [f]245 | 570 |
| 15 | [f]305 | 345 | 3,430 | 1,040 | 4,400 | 12,600 | 4,200 | 415 | 170 | 75 | 335 | 610 |
| 16 | 345 | 480 | 3,110 | 1,160 | 4,450 | 12,400 | 2,030 | [f]515 | 120 | 75 | 305 | [f]535 |
| 17 | 515 | [f]540 | 3,430 | 1,390 | 4,700 | [f]12,600 | [f]3,150 | 915 | 165 | [f]75 | [f]245 | 480 |
| 18 | [f]660 | 590 | 3,030 | 1,670 | 4,750 | 11,400 | 1,370 | 700 | [f]135 | 75 | 260 | 505 |
| 19 | 615 | 460 | 2,880 | 2,120 | 4,900 | 12,300 | [f]2,850 | [f]545 | 320 | 75 | 230 | [f]480 |
| 20 | 570 | [f]380 | 2,810 | 2,640 | 5,050 | 12,100 | 5,000 | 600 | 160 | [f]80 | [f]160 | 570 |
| 21 | [f]555 | 430 | 2,430 | 2,610 | 4,550 | [f]11,900 | [f]1,540 | 530 | [f]110 | 80 | 145 | 595 |
| 22 | 525 | 380 | 2,220 | 2,710 | 4,800 | 12,500 | 1,070 | [f]500 | 110 | 75 | 145 | [f]580 |
| 23 | 470 | 355 | 2,320 | 2,680 | 4,750 | 11,900 | 1,410 | 475 | 100 | [f]75 | [f]130 | 580 |
| 24 | [f]470 | 315 | 2,580 | 2,500 | 4,700 | [f]11,500 | [f]1,810 | 410 | 110 | 75 | 130 | [f]565 |
| 25 | 430 | 680 | 2,580 | 2,470 | 4,800 | 10,800 | 3,000 | [f]365 | 120 | 60 | 130 | 560 |
| 26 | 390 | 680 | 2,430 | 2,470 | 4,900 | 10,100 | 1,250 | 245 | [f]120 | 55 | [f]130 | 585 |
| 27 | [f]430 | 640 | 2,150 | 2,710 | 5,050 | [f]7,600 | [f]930 | [f]325 | 120 | 55 | 130 | 610 |
| 28 | 375 | 620 | 1,820 | 2,780 | 5,200 | 6,100 | 930 | 210 | 110 | 50 | 130 | [f]550 |
| 29 | 375 | ....... | 1,640 | 2,890 | 5,200 | 5,500 | 910 | 245 | [f]110 | [f]50 | [f]120 | 530 |
| 30 | [f]370 | ....... | 1,610 | 2,780 | 5,400 | 6,000 | [f]910 | [f]390 | 100 | 50 | 115 | 510 |
| 31 | 355 | ....... | 1,580 | ....... | 5,650 | ....... | 910 | 230 | ....... | 50 | ....... | [f]495 |

[a] Discharge computed from former measurements and checked by discharge of the lower Presidio station.

[b] Discharge computed from measurements of June and July, 1903.

[c] Water flowing across bottoms during the whole month. Discharge computed from those of the lower Presidio station, due allowance being made for flow of Rio Conchos.

[d] Over 50 per cent of the water passing this station during June was outside of channel. Discharges obtained by combining gage heights with flow at the lower Presidio station and of the Conchos.

[e] Discharge for gage heights above 5.5 feet when water leaves main channel above station and flows across bottom was obtained by combining gage height with flow at the lower Presidio station and of the Conchos.

[f] Meter measurements.

*Estimated monthly discharge of Rio Grande above Presidio, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 660 | 265 | 384 | 23,613 |
| February | 680 | 315 | 421 | 23,395 |
| March | 3,430 | 580 | 2,206 | 135,669 |
| April | 2,890 | 1,040 | 1,937 | 115,259 |
| May | 5,650 | 2,750 | 4,253 | 261,521 |
| June | 13,700 | 5,500 | 10,154 | 604,225 |
| July | 6,400 | 910 | 2,329 | 143,207 |
| August | 1,000 | 210 | 523 | 32,152 |
| September | 2,260 | 100 | 382 | 22,760 |
| October | 100 | 50 | 75 | 4,631 |
| November | 335 | 35 | 160 | 9,511 |
| December | 855 | 225 | 595 | 36,605 |
| The year | 13,700 | 35 | 1,952 | 1,412,548 |

## RIO CONCHOS NEAR OJINAGA, MEXICO.

*Discharge measurements of Rio Conchas 2 miles above mouth, near Ojinaga, Mexico.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| 1905. | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 18 | Jas. P. Hague | 527 | 1.77 | 2.5 | 935 |
| June 22 | do | 472 | 1.26 | 2.2 | 594 |
| July 4 | do | 294 | .97 | 1.5 | 285 |

**Note.** Above measurements made to determine the inflow between the upper and lower Presidio stations.

## RIO GRANDE BELOW PRESIDIO, TEX.

This station was established April 8, 1900, by the International (Water) Boundary Commission. It is 6 miles below Presidio; also below the mouth of Rio Conchos and about 215 miles below El Paso. It is at the west end of the canyon section of the Rio Grande. The discharge at this station minus the discharge at the station above Presidio, Tex., is the discharge of Rio Conchos, except at rare intervals, when some rain water enters the Rio Grande from the north.

The river is fairly straight at the station and for one-fourth mile above and below. The right bank is a rocky bluff. The left bank is an alluvial deposit and overflows for 750 feet back from the river, where gravel hills are found. The bed is shifting sand and is affected by a drainage line called Alamos Creek, which reaches the river one-fourth mile below the station. This is subject to torrential floods, which bring large quantities of bowlders and gravel into the Rio Grande, forming a temporary dam. This remains, throwing backwater onto the gage, until a flood in the river scours it out.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The tagged wire is extended across the bottom on the Texas side to the foot of the gravel hills. The initial point for soundings is the tagged-wire support at the hills on the left bank. A boat is provided for measuring flood flow across the bottom.

The gage is an inclined scantling bolted to posts sunk into the ground. There is an overflow gage at the gravel hills. This consists of a vertical staff nailed to a tree. The range between low and high water is about 23 feet. The highest recorded gage height is 26.35 feet, September 11, 1904. The extreme floods come from the Conchos. The bottom overflows at 13 feet on the gage. The bench mark is the top of a pine post sunk in the ground at the foot of the gravel hills at the left end of the tagged wire; elevation, 13.55 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is James P. Hague, and the gage reader, Felicitas Gonzales.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Papers):

Description: WS 50, p 355; 66, p 74; 84, p 175; 99, p 368; 132, p 75.
Discharge: WS 50, p 356; 66, p 74; 84, pp 175-176; 99, pp 369-372; 132, pp 75-78.
Discharge, mean daily: WS 132, p 79.
Discharge, monthly: Ann 22, iv, p 355; WS 75, p 158; WS 84, p 177; 99, p 373; 132, p 79.
Gage heights: WS 50, p 356; 66, p 75; 84, pp 176-177; 99, p 372; 132, p 78.
Hydrograph: WS 75, p 159.

*Discharge measurements of Rio Grande below Presidio, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 2 | Jas. P. Hague | 851 | 1.62 | 6.9 | 1,376 |
| January 5 | do | 772 | 1.40 | 6.7 | 1,078 |
| January 8 | do | 766 | 1.43 | 6.65 | 1,096 |
| January 11 | do | 756 | 1.42 | 6.55 | 1,071 |
| January 14 | do | 730 | 1.33 | 6.5 | 971 |
| January 17 | do | 741 | 1.34 | 6.55 | 995 |
| January 20 | do | 878 | 1.71 | 7.05 | 1,502 |
| January 23 | do | 859 | 1.64 | 6.9 | 1,407 |
| January 26 | do | 751 | 1.57 | 6.8 | 1,176 |
| January 29 | do | 656 | 1.49 | 6.6 | 978 |
| January 31 | do | 690 | 1.34 | 6.45 | 925 |
| February 3 | do | 656 | 1.37 | 6.4 | 899 |
| February 6 | do | 638 | 1.33 | 6.4 | 848 |
| February 9 | do | 611 | 1.30 | 6.35 | 795 |
| February 12 | do | 595 | 1.30 | 6.25 | 774 |
| February 15 | do | 580 | 1.25 | 6.1 | 724 |
| February 18 | do | 838 | 1.63 | 6.9 | 1,366 |
| February 21 | do | 976 | 1.99 | 7.5 | 1.945 |
| June 20 | do | 2,582 | 4.86 | 11.25 | 12,541 |
| June 23 | do | 2,568 | 4.86 | 11.2 | 12,473 |
| June 26 | do | 2,320 | 4.58 | 10.45 | 10,622 |
| June 29 | do | 1,867 | 3.46 | 9.3 | 6,456 |
| July 3 | do | 1,680 | 2.37 | 8.3 | 3,980 |
| July 7 | do | 1,582 | 2.03 | 7.9 | 3,219 |
| July 10 | do | 1,321 | 1.57 | 7.5 | 2,073 |
| July 13 | do | 1,224 | 1.37 | 7.2 | 1,677 |
| July 16 | do | 1,346 | 1.64 | 7.65 | 2,202 |
| July 18 | do | 1,752 | 3.57 | 8.85 | 6,249 |
| July 20 | do | 2,294 | 4.41 | 10.2 | 10,128 |
| July 22 | do | 2,229 | 4.45 | 10.1 | 9,910 |
| July 25 | do | 2,652 | 5.55 | 11.2 | 14,715 |
| July 28 | do | 2,705 | 6.05 | 11.65 | 16,355 |
| August 1 | do | 2,259 | 4.62 | 10.3 | 10,432 |
| August 4 | do | 1,548 | 2.78 | 8.6 | 4,303 |
| August 7 | do | 1,540 | 2.80 | 8.6 | 4,305 |
| August 9 | do | 1,468 | 2.61 | 8.4 | 3,836 |
| August 12 | do | 1,467 | 2.70 | 8.5 | 3,966 |
| August 15 | do | 1,857 | 5.02 | 10.0 | 9,319 |

*Discharge measurements of Rio Grande below Presidio, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | Jas. P. Hague | 2,767 | 5.89 | 11.7 | 16,301 |
| August 21 | do | 1,888 | 4.72 | 10.0 | 8,906 |
| August 24 | do | 1,783 | 4.52 | 9.7 | 8,058 |
| August 26 | do | 1,722 | 4.74 | 9.75 | 8,164 |
| August 28 | do | 1,568 | 3.82 | 8.9 | 5,994 |
| August 31 | do | 1,300 | 2.51 | 8.1 | 3,261 |
| September 3 | do | 914 | 2.68 | 7.6 | 2,449 |
| September 6 | do | 944 | 2.78 | 7.6 | 2,622 |
| September 11 | do | 2,313 | 4.82 | 10.65 | 11,150 |
| September 14 | do | 2,303 | 4.70 | 10.55 | 10,827 |
| September 17 | do | 1,780 | 4.59 | 9.8 | 8,179 |
| September 20 | do | 1,085 | 3.81 | 8.55 | 4,135 |
| September 23 | do | 2,933 | 7.06 | 12.3 | 20,719 |
| September 27 | do | 2,407 | 5.20 | 10.95 | 12,520 |
| September 30 | do | 2,430 | 5.34 | 11.05 | 12,984 |
| October 3 | do | 2,718 | 5.72 | 11.45 | 15,550 |
| October 6 | do | 2,553 | 5.38 | 11.1 | 13,728 |
| October 9 | do | 1,641 | 4.05 | 8.95 | 6,645 |
| October 12 | do | 1,588 | 3.59 | 8.6 | 5,703 |
| October 15 | do | 1,056 | 2.88 | 7.9 | 3,042 |
| October 18 | do | 1,126 | 2.48 | 7.7 | 2,791 |
| October 21 | do | 1,164 | 2.06 | 7.5 | 2,402 |
| October 24 | do | 1,002 | 1.85 | 7.2 | 1,857 |
| October 28 | do | 972 | 1.54 | 7.0 | 1,501 |
| October 31 | do | 954 | 1.41 | 7.0 | 1,347 |
| November 3 | do | 866 | 1.50 | 6.75 | 1,295 |
| November 7 | do | 1,489 | 3.69 | 8.75 | 5,501 |
| November 10 | do | 2,265 | 4.83 | 10.75 | 10,940 |
| November 13 | do | 1,547 | 4.73 | 9.4 | 7,319 |
| November 16 | do | 1,420 | 4.63 | 9.15 | 6,568 |
| November 19 | do | 1,489 | 4.80 | 9.3 | 7,143 |
| November 22 | do | 1,377 | 3.72 | 8.65 | 5,119 |
| November 25 | do | 1,131 | 2.66 | 7.9 | 3,008 |
| November 28 | do | 1,076 | 2.59 | 7.65 | 2,787 |
| December 2 | do | 1,548 | 4.45 | 9.2 | 6,891 |
| December 5 | do | 1,312 | 4.04 | 8.6 | 5,306 |
| December 8 | do | 1,140 | 3.49 | 8.2 | 3,975 |
| December 10 | do | 1,016 | 3.17 | 7.9 | 3,224 |
| December 14 | do | 908 | 2.82 | 7.6 | 2,558 |
| December 17 | do | 1,438 | 4.39 | 9.1 | 6,318 |
| December 20 | do | 1,491 | 4.68 | 9.2 | 6,974 |
| December 23 | do | 1,610 | 4.82 | 9.45 | 7,760 |
| December 27 | do | 1,317 | 4.12 | 8.6 | 5,430 |
| December 30 | do | 1,262 | 2.91 | 8.1 | 3,677 |

*Daily gage height, in feet, of Rio Grande below Presidio, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.9 | 6.4 | 7.35 | 7.75 | 8.15 | 9.3 | 9.45 | 10.3 | 7.95 | 10.5 | 6.9 | 7.7 |
| 2 | 6.85 | 6.4 | 7.3 | 7.6 | 8.3 | 9.35 | 8.8 | 9.75 | 7.85 | 11.4 | 6.8 | 9.3 |
| 3 | 6.8 | 6.4 | 7.35 | 7.6 | 8.45 | 9.4 | 8.4 | 9.1 | 7.6 | 11.2 | 6.75 | 9.4 |
| 4 | 6.8 | 6.4 | 7.15 | 7.5 | 8.3 | 9.6 | 8.3 | 8.8 | 7.6 | 10.6 | 6.7 | 8.7 |
| 5 | 6.75 | 6.4 | 7.4 | 7.45 | 8.35 | 9.85 | 8.2 | 8.75 | 7.75 | 10.75 | 6.95 | 8.55 |
| 6 | 6.7 | 6.4 | 7.85 | 7.65 | 8.45 | 10.05 | 8.15 | 8.6 | 7.75 | 11.3 | 7.7 | 8.45 |
| 7 | 6.7 | 6.5 | 7.95 | 7.7 | 8.5 | 10.35 | 7.9 | 8.55 | 9.4 | 11.0 | 8.8 | 8.25 |
| 8 | 6.65 | 6.45 | 8.1 | 7.65 | 8.55 | 10.5 | 7.6 | 8.5 | 9.55 | 9.75 | 9.8 | 8.15 |
| 9 | 6.6 | 6.35 | 8.15 | 7.65 | 8.5 | 10.75 | 7.65 | 8.35 | 11.35 | 9.05 | 10.3 | 8.0 |
| 10 | 6.6 | 6.3 | 8.1 | 7.65 | 8.65 | 11.15 | 7.55 | 8.5 | 11.3 | 8.85 | 10.7 | 7.85 |
| 11 | 6.55 | 6.3 | 8.15 | 7.6 | 8.6 | 11.55 | 7.5 | 8.6 | 10.75 | 8.65 | 11.6 | 7.8 |
| 12 | 6.5 | 6.25 | 8.25 | 7.45 | 8.55 | 11.7 | 7.3 | 8.55 | 10.7 | 8.6 | 10.75 | 7.75 |
| 13 | 6.5 | 6.1 | 8.2 | 7.4 | 8.6 | 12.15 | 7.2 | 9.05 | 10.45 | 8.3 | 9.3 | 7.7 |
| 14 | 6.5 | 6.1 | 8.25 | 7.4 | 8.7 | 12.6 | 7.2 | 9.6 | 10.45 | 8.1 | 9.3 | 7.6 |
| 15 | 6.5 | 6.1 | 8.4 | 7.4 | 8.8 | 12.35 | 8.8 | 10.2 | 10.45 | 7.9 | 9.55 | 8.05 |
| 16 | 6.5 | 6.3 | 8.3 | 7.35 | 8.8 | 12.0 | 7.8 | 10.0 | 10.05 | 7.75 | 9.2 | 8.85 |
| 17 | 6.55 | 6.95 | 8.6 | 7.4 | 8.9 | 11.35 | 10.35 | 10.45 | 9.75 | 7.7 | 9.4 | 9.15 |
| 18 | 6.7 | 6.85 | 8.6 | 7.7 | 8.95 | 11.15 | 8.45 | 11.7 | 9.05 | 7.7 | 9.6 | 9.5 |
| 19 | 6.85 | 7.45 | 8.45 | 7.8 | 8.95 | 11.25 | 9.4 | 10.9 | 8.85 | 7.65 | 9.2 | 10.0 |
| 20 | 7.05 | 7.45 | 8.45 | 7.9 | 9.0 | 11.3 | 10.65 | 10.5 | 8.55 | 7.6 | 9.1 | 9.5 |
| 21 | 6.9 | 7.5 | 8.35 | 8.1 | 8.95 | 11.35 | 10.2 | 10.0 | 8.7 | 7.5 | 8.9 | 9.75 |
| 22 | 6.9 | 7.4 | 8.15 | 8.1 | 9.0 | 11.45 | 9.85 | 9.65 | 9.65 | 7.45 | 8.55 | 10.0 |
| 23 | 6.9 | 7.5 | 8.1 | 7.85 | 9.25 | 11.25 | 10.6 | 9.75 | 11.95 | 7.35 | 8.25 | 9.4 |
| 24 | 6.9 | 7.2 | 8.05 | 7.8 | 9.05 | 11.05 | 10.6 | 9.8 | 13.35 | 7.25 | 8.2 | 9.0 |
| 25 | 6.8 | 7.2 | 8.2 | 7.8 | 8.9 | 10.8 | 11.25 | 10.2 | 14.45 | 7.2 | 8.05 | 8.75 |
| 26 | 6.8 | 7.4 | 8.15 | 7.95 | 8.9 | 10.5 | 11.4 | 9.75 | 13.25 | 7.15 | 7.8 | 8.65 |
| 27 | 6.75 | 7.5 | 8.15 | 8.0 | 9.05 | 9.85 | 11.55 | 9.5 | 10.9 | 7.1 | 7.75 | 8.6 |
| 28 | 6.7 | 7.45 | 8.1 | 8.15 | 9.2 | 9.4 | 11.75 | 9.0 | 10.3 | 7.0 | 7.65 | 8.45 |
| 29 | 6.6 | ....... | 7.9 | 8.1 | 9.1 | 9.3 | 11.05 | 8.45 | 10.35 | 7.0 | 7.55 | 8.35 |
| 30 | 6.5 | ....... | 7.8 | 8.15 | 9.0 | 9.3 | 10.55 | 8.35 | 11.3 | 7.0 | 7.7 | 8.15 |
| 31 | 6.45 | ....... | 7.7 | ....... | 9.15 | ....... | 10.3 | 8.15 | ....... | 7.0 | ....... | 8.0 |

*Daily discharge, in second-feet, of Rio Grande below Presidio, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr.[a] | May.[a] | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,360 | 900 | 2,050 | 2,630 | 2,970 | 6,400 | 6,830 | [b]10,430 | 3,000 | 11,750 | 1,320 | 2,880 |
| 2 | [b]1,330 | 900 | 1,980 | 2,410 | 3,270 | 6,580 | 5,220 | 8,440 | 2,850 | 15,200 | 1,300 | [b]7,160 |
| 3 | 1,250 | [b]900 | 2,050 | 2,380 | 3,650 | 6,770 | [b]4,230 | 6,100 | [b]2,450 | [b]14,130 | [b]1,290 | 7,420 |
| 4 | 1,220 | 880 | 1,750 | 2,230 | 3,270 | 7,510 | 3,980 | [b]5,020 | 2,510 | 12,080 | 1,270 | 5,560 |
| 5 | [b]1,130 | 860 | 2,130 | 2,140 | 3,390 | 8,450 | 3,790 | 4,840 | 2,810 | 12,570 | 1,710 | [b]5,150 |
| 6 | 1,100 | [b]850 | 2,840 | 2,350 | 3,650 | 9,210 | 3,690 | 4,300 | [b]2,870 | [b]14,530 | 3,300 | 4,810 |
| 7 | 1,120 | 950 | 3,000 | 2,390 | 3,800 | 10,330 | [b]3,220 | [b]4,190 | 7,680 | 13,400 | [b]5,640 | 4,140 |
| 8 | [b]1,100 | 900 | 3,250 | 2,290 | 3,940 | 10,800 | 2,360 | 4,070 | 8,100 | 9,280 | 8,360 | [b]3,850 |
| 9 | 1,090 | [b]800 | 3,330 | 2,260 | 3,800 | 11,400 | 2,500 | [b]3,670 | 13,140 | [b]6,970 | 9,720 | 3,480 |
| 10 | 1,080 | 790 | 3,250 | 2,260 | 4,230 | 12,360 | [b]2,210 | 4,070 | 13,000 | 6,370 | [b]10,810 | [b]3,110 |
| 11 | [b]1,070 | 790 | 3,330 | 2,200 | 4,090 | 13,410 | 2,070 | 4,300 | [b]11,440 | 5,830 | 13,500 | 3,000 |
| 12 | 1,010 | [b]770 | 3,500 | 2,020 | 3,940 | 13,880 | 1,810 | [b]4,140 | 11,300 | [b]5,700 | 10,940 | 2,890 |
| 13 | 990 | 720 | 3,420 | 1,960 | 4,090 | 15,410 | [b]1,680 | 5,930 | 10,500 | 4,610 | [b]7,020 | 2,780 |
| 14 | [b]970 | 720 | 3,500 | 1,960 | 4,380 | 16,940 | 1,680 | 7,900 | [b]10,500 | 3,820 | 7,020 | [b]2,560 |
| 15 | 970 | [b]720 | 3,760 | 1,960 | 4,670 | 16,090 | 6,080 | [b]10,100 | 10,500 | [b]3,040 | 7,770 | 3,680 |
| 16 | 970 | 880 | 3,590 | 1,900 | 4,670 | 14,900 | [b]2,650 | 9,320 | 9,080 | 2,860 | [b]6,720 | 5,680 |
| 17 | [b]1,000 | 1,400 | 4,110 | 1,960 | 4,980 | 12,850 | 10,730 | 11,100 | [b]8,010 | 2,790 | 7,440 | [b]6,420 |
| 18 | 1,150 | 1,320 | 4,110 | 2,830 | 5,140 | 12,340 | [b]4,910 | [b]16,300 | 5,750 | [b]2,790 | 8,040 | 7,460 |
| 19 | 1,300 | 1,900 | 3,840 | 2,460 | 5,140 | 12,560 | 7,830 | 12,600 | 5,100 | 2,690 | [b]6,840 | 8,840 |
| 20 | [b]1,500 | 1,900 | 3,840 | 2,600 | 5,310 | [b]12,660 | [b]11,930 | 10,900 | [b]4,130 | 2,590 | 6,530 | [b]7,720 |
| 21 | 1,410 | [b]1,950 | 3,670 | 2,890 | 5,140 | 12,810 | 10,130 | [b]8,910 | 4,610 | [b]2,400 | 5,900 | 8,400 |
| 22 | 1,410 | 1,870 | 3,330 | 2,890 | 5,310 | 13,100 | [b]9,160 | 7,920 | 8,790 | 2,310 | [b]4,840 | 9,080 |
| 23 | [b]1,410 | 1,990 | 3,250 | 2,530 | 6,210 | [b]12,600 | 12,080 | 8,200 | [b]19,140 | 2,130 | 4,000 | [b]7,630 |
| 24 | 1,360 | 1,710 | 3,160 | 2,460 | 5,490 | 12,120 | 12,080 | [b]8,340 | 23,870 | [b]1,950 | 3,850 | 6,520 |
| 25 | 1,220 | 1,730 | 3,420 | 2,460 | 4,980 | 11,510 | [b]14,900 | 9,700 | 27,170 | 1,860 | [b]3,430 | 5,830 |
| 26 | [b]1,180 | 1,950 | 3,330 | 2,670 | 4,980 | [b]10,770 | 15,440 | [b]8,160 | 22,130 | 1,770 | 2,920 | 5,560 |
| 27 | 1,130 | 2,070 | 3,330 | 2,740 | 5,490 | 8,470 | 15,990 | 7,520 | [b]12,300 | 1,680 | 2,880 | [b]5,430 |
| 28 | 1,080 | 2,040 | 3,250 | 2,970 | 6,030 | 6,810 | [b]16,750 | [b]6,250 | 9,540 | [b]1,500 | [b]2,790 | 4,900 |
| 29 | [b]980 | ....... | 2,920 | 2,890 | 5,670 | [b]6,460 | 13,960 | 4,800 | 9,770 | 1,450 | 2,690 | 4,550 |
| 30 | 950 | ....... | 2,760 | 2,970 | 5,310 | 6,460 | 11,960 | 4,120 | 14,130 | [b]1,400 | 2,880 | [b]3,850 |
| 31 | [b]930 | ....... | 2,600 | ....... | 5,850 | ....... | 10,960 | [b]3,430 | ....... | 1,350 | ....... | 3,530 |

[a] Daily discharges computed from measurements of November, 1904, and June, 1905.
[b] Meter measurements.

*Estimated monthly discharge of Rio Grande below Presidio, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 1,500 | 930 | 1,154 | 70,949 |
| February | 2,070 | 720 | 1,256 | 69,739 |
| March | 4,110 | 1,750 | 3,150 | 193,686 |
| April | 2,970 | 1,900 | 2,405 | 143,127 |
| May | 6,210 | 2,970 | 4,608 | 283,319 |
| June | 16,940 | 6,400 | 11,065 | 658,433 |
| July | 16,750 | 1,680 | 7,510 | 461,772 |
| August | 16,300 | 3,430 | 7,260 | 446,420 |
| September | 27,170 | 2,450 | 9,872 | 587,445 |
| October | 15,200 | 1,350 | 5,574 | 342,744 |
| November | 13,500 | 1,270 | 5,424 | 322,750 |
| December | 9,080 | 2,560 | 5,286 | 325,031 |
| The year | 27,170 | 720 | 5,380 | 3,905,415 |

## RIO GRANDE NEAR LANGTRY, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is located one-half mile south of Langtry station, on the southern Pacific Railroad, and is about 440 miles below El Paso, Tex., at the east end of the canyon section of the Rio Grande, and a short distance to the west of the mouth of Pecos River, one of the principal tributaries of the Rio Grande.

The river is nearly straight for 1 mile above and one-half mile below the station. The right (Mexican) bank is a rock bluff. The left bank is alluvial deposit for 200 feet back to a rock bluff. The bed of the river is shifting sand, as is also the left bank.

Discharge measurements are made by means of a cable of 490 feet span, car, tagged wire, and guy wire. The initial point for soundings is the pole supporting the cable on the left bank.

The gage is a vertical staff, bolted to the bluff on the right bank. It is read from the left bank with the aid of field glasses. The range between high and low water is about 36 feet. The highest recorded gage is 36.5 feet, September 13, 1904. The bottom begins to overflow at gage height 29.5 feet and the overflow extends 110 feet back from the cable pole. This bottom is densely wooded. The bench mark is a cross cut on a large bowlder at the bluff on the Texas side, in line with the cable; elevation, 40.56 feet above the datum of the gage.

Observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer was E. E. Winter and the gage reader was W. H. Dodd.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 357; 66, p 75; 84, p 172; 99, p 365; 132, p 80.
Discharge: WS 50, p 357; 66, pp 75-76; 84, pp 172-173; 99, pp 365-367; 132, pp 80-81.
Discharge, mean daily: WS 132, p 83.
Discharge, monthly: Ann 22, iv, p 355; WS 75, p 160; 84, p 174; 99, p 368; 132, p 83.
Gage heights: WS 50, p 358; 66, p 76; 84, p 174; 99, pp 367-368; 132, p 82.

*Discharge measurements of Rio Grande near Langtry, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 2 | E. E. Winter | 658 | 2.36 | 1.6 | 1,552 |
| January 6 | do | 642 | 2.30 | 1.55 | 1,474 |
| January 11 | do | 618 | 2.02 | 1.4 | 1,248 |
| January 14 | do | 625 | 1.93 | 1.3 | 1,207 |
| January 19 | do | 585 | 1.88 | 1.1 | 1,097 |
| January 23 | do | 628 | 2.06 | 1.4 | 1,296 |
| January 28 | do | 587 | 2.10 | 1.5 | 1,234 |
| February 2 | do | 607 | 1.72 | 1.3 | 1,045 |
| February 6 | do | 568 | 1.62 | 1.2 | 922 |
| February 10 | do | 571 | 1.59 | 1.2 | 909 |
| February 14 | do | 531 | 2.02 | 1.1 | 1,070 |
| February 18 | do | 520 | 1.95 | 1.0 | 1,012 |
| February 25 | do | 713 | 2.71 | 1.9 | 1,932 |
| March 6 | do | 840 | 2.49 | 2.2 | 2,091 |
| March 10 | do | 1,162 | 3.28 | 3.1 | 3,810 |
| March 15 | do | 1,187 | 3.21 | 3.3 | 3,810 |
| March 19 | do | 944 | 3.00 | 3.0 | 2,831 |
| March 23 | do | 968 | 3.07 | 3.0 | 2,976 |
| March 28 | do | 883 | 2.83 | 2.7 | 2,496 |
| April 3 | do | 732 | 2.46 | 2.3 | 1,800 |

*Discharge measurements of Rio Grande near Langtry, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 7 | E. E. Winter | 789 | 2.62 | 2.0 | 2,068 |
| April 11 | do | 774 | 2.84 | 1.9 | 2,200 |
| April 15 | do | 777 | 2.94 | 1.9 | 2,283 |
| April 20 | do | 791 | 2.99 | 1.7 | 2,365 |
| April 24 | do | 956 | 2.99 | 2.4 | 2,860 |
| April 27 | do | 889 | 2.97 | 2.4 | 2,640 |
| May 2 | do | 957 | 3.14 | 2.6 | 3,005 |
| May 6 | do | 1,037 | 3.59 | 2.7 | 3,728 |
| May 10[a] | do | 868 | 2.86 | 3.4 | 2,486 |
| May 15 | do | 1,087 | 3.57 | 3.3 | 3,881 |
| May 19 | do | 1,158 | 4.11 | 3.4 | 4,763 |
| May 24 | do | 1,184 | 3.81 | 3.5 | 4,509 |
| May 29 | do | 1,175 | 3.55 | 3.4 | 4,170 |
| June 2 | do | 1,120 | 4.25 | 3.8 | 4,759 |
| June 8 | do | 1,532 | 5.01 | 5.2 | 7,671 |
| June 12 | do | 2,344 | 5.66 | 6.8 | 13,278 |
| June 16 | do | 3,167 | 5.96 | 8.5 | 18,887 |
| June 20 | do | 2,538 | 5.09 | 7.1 | 12,925 |
| June 24 | do | 2,481 | 5.28 | 7.3 | 13,105 |
| June 28 | do | 1,718 | 4.38 | 5.9 | 7,524 |
| July 3 | do | 1,129 | 4.06 | 4.1 | 4,589 |
| July 8 | do | 984 | 3.58 | 2.8 | 3,518 |
| July 14 | do | 760 | 3.25 | 2.0 | 2,472 |
| July 19 | do | 1,056 | 3.36 | 3.2 | 3,550 |
| July 24 | do | 1,403 | 4.65 | 4.8 | 6,524 |
| July 29 | do | 1,659 | 5.16 | 6.1 | 8,567 |
| August 4 | do | 1,350 | 4.45 | 3.9 | 6,004 |
| August 10 | do | 1,126 | 3.55 | 3.2 | 4,002 |
| August 14 | do | 1,658 | 4.67 | 5.2 | 7,743 |
| August 19 | do | 1,724 | 4.92 | 5.55 | 8,480 |
| August 24 | do | 1,433 | 4.74 | 4.4 | 6,788 |
| August 28 | do | 1,444 | 4.75 | 4.5 | 6,864 |
| September 2 | do | 997 | 3.61 | 2.7 | 3,597 |
| September 7 | do | 848 | 3.47 | 2.15 | 2,942 |
| September 10 | do | 1,643 | 4.52 | 5.65 | 7,431 |
| September 16 | do | 1,355 | 3.95 | 4.4 | 5,359 |
| September 22 | do | 1,017 | 3.72 | 3.0 | 3,785 |
| September 25 | do | 1,672 | 4.78 | 5.65 | 7,984 |
| September 28 | do | 3,324 | 7.13 | 10.85 | 23,694 |
| October 2 | do | 1,693 | 5.16 | 6.35 | 8,731 |
| October 6 | do | 1,355 | 4.88 | 5.0 | 6,609 |
| October 10 | do | 1,310 | 4.71 | 4.65 | 6,169 |
| October 14 | do | 1,035 | 3.71 | 3.25 | 3,840 |
| October 19 | do | 980 | 3.52 | 2.5 | 3,453 |
| October 23 | do | 818 | 3.34 | 2.0 | 2,733 |
| October 28 | do | 766 | 2.98 | 1.7 | 2,283 |
| November 2 | do | 769 | 2.62 | 1.6 | 2,012 |
| November 6 | do | 751 | 1.87 | 1.3 | 1,407 |
| November 9 | do | 733 | 1.80 | 1.3 | 1,320 |
| November 13 | do | 1,004 | 3.13 | 2.7 | 3,145 |
| November 17 | do | 1,302 | 3.52 | 4.0 | 4,583 |
| November 21 | do | 1,342 | 3.64 | 4.1 | 4,888 |

[a] Channel filled with mud washed in by local rains.

*Discharge measurements of Rio Grande near Langtry, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| November 28 | E. E. Winter | 942 | 3.74 | 2.4 | 3,523 |
| November 30 | do | 784 | 3.70 | 2.0 | 2,902 |
| December 3 | H. F. Collins | 839 | 3.87 | 2.1 | 3,248 |
| December 9 | do | 1,047 | 3.83 | 2.85 | 4,008 |
| December 12 | do | 931 | 3.75 | 2.2 | 3,493 |
| December 17 | do | 817 | 3.59 | 2.0 | 2,937 |
| December 20 | do | 1,500 | 5.62 | 4.2 | 8,434 |
| December 25 | do | 1,589 | 5.85 | 4.6 | 9,299 |
| December 31 | do | 990 | 4.19 | 2.7 | 4,144 |

*Daily gage height, in feet, of Rio Grande near Langtry, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 1.4 | 1.9 | 5.4 | 2.45 | 3.5 | 10.2 | 5.2 | 2.95 | 5.5 | 1.6 | 1.9 |
| 2 | 1.7 | 1.25 | 1.9 | 2.6 | 2.6 | 3.85 | 5.35 | 4.8 | 2.65 | 6.75 | 1.6 | 1.9 |
| 3 | 1.6 | 1.2 | 1.9 | 2.4 | 2.6 | 3.8 | 4.2 | 4.1 | 2.55 | 7.3 | 1.55 | 2.05 |
| 4 | 1.6 | 1.15 | 1.95 | 2.25 | 2.6 | 3.9 | 3.7 | 3.9 | 2.5 | 6.4 | 1.5 | 3.2 |
| 5 | 1.6 | 1.05 | 2.3 | 2.15 | 2.65 | 3.9 | 3.65 | 3.75 | 2.55 | 5.4 | 1.45 | 3.85 |
| 6 | 1.55 | 1.15 | 2.3 | 2.0 | 2.7 | 4.05 | 3.55 | 3.5 | 2.15 | 4.9 | 1.3 | 3.55 |
| 7 | 1.5 | 1.05 | 2.3 | 2.0 | 2.7 | 4.55 | 2.8 | 3.45 | 2.15 | 5.7 | 1.3 | 3.4 |
| 8 | 1.5 | 1.1 | 2.5 | 2.0 | 2.8 | 5.25 | 2.8 | 3.35 | 2.7 | 6.65 | 1.3 | 3.15 |
| 9 | 1.5 | 1.2 | 4.35 | 2.05 | 5.1 | 5.7 | 2.65 | 3.2 | 2.9 | 5.55 | 1.3 | 2.85 |
| 10 | 1.45 | 1.15 | 3.05 | 2.05 | 3.45 | 5.65 | 2.4 | 3.2 | 6.25 | 4.6 | 1.3 | 2.55 |
| 11 | 1.4 | 1.1 | 2.8 | 1.95 | 3.2 | 5.8 | 2.25 | 3.1 | 9.5 | 4.15 | 1.3 | 2.4 |
| 12 | 1.4 | 1.1 | 2.8 | 1.9 | 3.7 | 6.95 | 2.2 | 2.9 | 5.4 | 3.75 | 1.3 | 2.25 |
| 13 | 1.3 | 1.1 | 2.9 | 1.9 | 4.0 | 7.0 | 2.1 | 5.95 | 5.1 | 3.6 | 2.0 | 2.2 |
| 14 | 1.3 | 1.1 | 2.9 | 1.9 | 3.95 | 7.7 | 2.0 | 5.1 | 4.5 | 3.15 | 4.3 | 2.1 |
| 15 | 1.3 | 1.1 | 3.35 | 1.9 | 3.35 | 8.15 | 1.95 | 5.35 | 4.4 | 2.95 | 7.0 | 2.1 |
| 16 | 1.25 | 1.0 | 3.1 | 1.9 | 3.25 | 8.65 | 1.9 | 5.75 | 4.4 | 2.85 | 4.55 | 2.0 |
| 17 | 1.2 | 1.0 | 3.0 | 1.8 | 3.3 | 8.3 | 2.15 | 6.3 | 4.95 | 2.8 | 4.0 | 2.0 |
| 18 | 1.2 | 1.0 | 3.0 | 1.7 | 3.3 | 7.1 | 3.25 | 5.55 | 4.8 | 2.5 | 4.5 | 2.55 |
| 19 | 1.1 | 1.0 | 3.0 | 1.7 | 3.35 | 7.35 | 3.25 | 6.25 | 3.95 | 2.45 | 4.6 | 4.0 |
| 20 | 1.1 | 1.0 | 3.05 | 1.7 | 3.4 | 7.15 | 3.75 | 6.7 | 3.5 | 2.25 | 4.15 | 4.25 |
| 21 | 1.1 | 1.2 | 3.25 | 1.7 | 3.5 | 7.3 | 3.9 | 7.05 | 3.05 | 2.1 | 4.05 | 4.2 |
| 22 | 1.1 | 1.4 | 3.1 | 1.7 | 3.5 | 7.2 | 4.65 | 5.95 | 2.9 | 2.0 | 3.7 | 4.0 |
| 23 | 1.25 | 2.0 | 3.0 | 2.35 | 3.5 | 7.25 | 5.35 | 4.65 | 2.7 | 1.95 | 3.2 | 4.5 |
| 24 | 1.7 | 1.9 | 2.9 | 2.4 | 4.15 | 7.25 | 4.85 | 4.35 | 2.7 | 1.9 | 2.8 | 5.25 |
| 25 | 1.65 | 1.85 | 2.75 | 2.4 | 3.7 | 7.1 | 7.55 | 5.65 | 5.6 | 1.8 | 2.55 | 4.6 |
| 26 | 1.6 | 1.8 | 2.7 | 2.4 | 3.5 | 7.0 | 5.4 | 5.15 | 8.4 | 1.8 | 2.4 | 3.9 |
| 27 | 1.6 | 1.8 | 2.7 | 2.4 | 3.5 | 6.3 | 5.3 | 4.95 | 10.4 | 1.75 | 2.4 | 3.6 |
| 28 | 1.5 | 1.8 | 2.7 | 2.75 | 3.4 | 5.65 | 5.5 | 4.5 | 10.3 | 1.7 | 2.35 | 3.25 |
| 29 | 1.5 | ....... | 2.7 | 2.55 | 3.6 | 7.5 | 6.15 | 4.05 | 6.6 | 1.6 | 2.2 | 3.05 |
| 30 | 1.45 | ....... | 2.7 | 2.4 | 3.45 | 11.1 | 6.4 | 3.65 | 5.65 | 1.6 | 1.95 | 2.85 |
| 31 | 1.4 | ....... | 2.5 | ....... | 3.5 | ....... | 6.15 | 3.3 | ....... | 1.6 | ....... | 2.7 |

*Daily discharge, in second-feet, of Rio Grande near Langtry, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,350 | 1,130 | 1,930 | 7,700 | 2,700 | 4,370 | 25,700 | 7,520 | 4,000 | 7,830 | 2,100 | 2,760 |
| 2 | [a]1,550 | [a]990 | 1,930 | 2,100 | 3,000 | [a]4,860 | 6,420 | 7,050 | [a]3,540 | [a]9,930 | [a]2,010 | 2,760 |
| 3 | 1,550 | 930 | 1,930 | [a]1,900 | 3,130 | 4,760 | [a]4,690 | 6,230 | 3,420 | 11,580 | 1,910 | [a]3,130 |
| 4 | 1,550 | 870 | 1,960 | 1,890 | 3,260 | 4,960 | 4,260 | [a]6,000 | 3,360 | 8,880 | 1,810 | 4,350 |
| 5 | 1,550 | 760 | 2,190 | 1,930 | 3,490 | 4,960 | 4,220 | 5,600 | 3,420 | 7,240 | 1,710 | 5,000 |
| 6 | [a]1,470 | [a]880 | [a]2,190 | 1,920 | [a]3,730 | 5,270 | 4,140 | 5,000 | 2,940 | [a]6,480 | [a]1,410 | 4,700 |
| 7 | 1,400 | 820 | 2,280 | [a]2,070 | 3,730 | 6,310 | 3,520 | 4,800 | [a]2,940 | 7,800 | 1,380 | 4,550 |
| 8 | 1,400 | 850 | 2,660 | 2,130 | 3,930 | [a]7,770 | [a]3,520 | 4,500 | 3,600 | 9,630 | 1,350 | 4,300 |
| 9 | 1,400 | 910 | 6,690 | 2,220 | 6,530 | 9,420 | 3,320 | 4,100 | 3,850 | 7,580 | [a]1,320 | [a]4,010 |
| 10 | 1,320 | [a]880 | [a]3,710 | 2,280 | [a]2,590 | 9,250 | 3,000 | [a]4,000 | [a]9,530 | [a]6,090 | 1,300 | 3,770 |
| 11 | 1,250 | 910 | 3,130 | [a]2,240 | 2,410 | 9,770 | 2,800 | 3,800 | 22,500 | 5,330 | 1,280 | 3,650 |
| 12 | [a]1,250 | 960 | 3,050 | 2,220 | 3,730 | [a]13,770 | 2,730 | 3,400 | 8,150 | 4,670 | 1,260 | [a]3,530 |
| 13 | 1,210 | 1,020 | 3,170 | 2,240 | 4,650 | 13,940 | 2,600 | 9,240 | 7,320 | 4,420 | [a]2,240 | 3,490 |
| 14 | [a]1,210 | [a]1,070 | 3,090 | 2,260 | 4,870 | 16,250 | [a]2,470 | [a]7,540 | 5,640 | [a]3,780 | 5,480 | 3,210 |
| 15 | 1,210 | 1,070 | [a]3,910 | [a]2,280 | [a]3,980 | 17,730 | 2,420 | 8,050 | 5,360 | 3,680 | 13,880 | 3,210 |
| 16 | 1,180 | 1,010 | 3,310 | 2,340 | 3,950 | [a]19,380 | 2,380 | 8,870 | [a]5,360 | 3,630 | 6,230 | 2,940 |
| 17 | 1,150 | 1,010 | 3,020 | 2,300 | 4,220 | 18,040 | 2,600 | 9,980 | 6,900 | 3,600 | [a]4,580 | [a]2,940 |
| 18 | 1,150 | [a]1,010 | 2,930 | 2,250 | 4,390 | 12,930 | 3,620 | 8,480 | 6,480 | 3,450 | 6,080 | 4,310 |
| 19 | [a]1,100 | 1,010 | [a]2,830 | 2,300 | [a]4,660 | 14,000 | [a]3,640 | [a]9,880 | 5,200 | [a]3,380 | 6,380 | 7,940 |
| 20 | 1,100 | 1,010 | 2,960 | [a]2,360 | 4,670 | [a]12,970 | 4,570 | 10,780 | 4,530 | 3,090 | 5,040 | [a]8,540 |
| 21 | 1,100 | 1,210 | 3,400 | 2,360 | 4,780 | 13,100 | 4,850 | 11,480 | 3,850 | 2,870 | [a]4,850 | 8,430 |
| 22 | 1,100 | 1,420 | 3,140 | 2,370 | 4,690 | 13,010 | 6,240 | 9,530 | [a]3,670 | 2,730 | 4,570 | 8,000 |
| 23 | [a]1,200 | 2,030 | [a]2,980 | 2,820 | 4,600 | 13,050 | 7,540 | 7,230 | 3,450 | [a]2.650 | 4,170 | 9,080 |
| 24 | 1,500 | 1,930 | 2,820 | [a]2,860 | [a]5,810 | [a]13,050 | [a]6,600 | [a]6,700 | 3,450 | 2,580 | 3,850 | 10,700 |
| 25 | 1,430 | [a]1,880 | 2,580 | 2,780 | 4,880 | 12,300 | 14,700 | 9,300 | [a]7,900 | 2,430 | 3,640 | [a]9,300 |
| 26 | 1,370 | 1,830 | 2,500 | 2,710 | 4,450 | 11,910 | 7,460 | 8,230 | 16 280 | 2,430 | 3,520 | 7,400 |
| 27 | 1,370 | 1,830 | 2,500 | [a]2,640 | 4,420 | 9,120 | 7,300 | 7,800 | 22,340 | 2,350 | 3,520 | 6,590 |
| 28 | [a]1,230 | 1,830 | [a]2,500 | 2,990 | 4,190 | [a]7,020 | 7,620 | [a]6,860 | [a]22,030 | [a]2,280 | [a]3,440 | 5,640 |
| 29 | 1,230 | ....... | 2,500 | 2,790 | [a]4,570 | 14,600 | [a]8,650 | 5,960 | 10,830 | 2,200 | 3,210 | 5,100 |
| 30 | 1,180 | ....... | 2,500 | 2,640 | 4,270 | 29,300 | 9,170 | 5,160 | 7,980 | 2,200 | [a]2,830 | 4,560 |
| 31 | 1,130 | ....... | 2,180 | ....... | 4,370 | ....... | 8,670 | 4,460 | ....... | 2,200 | ....... | [a]4,140 |

[a] Meter measurements.

*Estimated monthly discharge of Rio Grande near Langtry, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 1,550 | 1,100 | 1,296 | 79,716 |
| February | 2,030 | 760 | 1,181 | 65,574 |
| March | 6,690 | 1,930 | 2,854 | 175,477 |
| April | 7,700 | 1,890 | 2,530 | 150,526 |
| May | 6,530 | 2,410 | 4,150 | 255,174 |
| June | 29,300 | 4,370 | 11,572 | 688,602 |
| July | 25,700 | 2,380 | 5,852 | 359,841 |
| August | 11,480 | 3,400 | 7,017 | 431,464 |
| September | 22,500 | 2,940 | 7,327 | 436,007 |
| October | 11,580 | 2,200 | 4,806 | 295,517 |
| November | 13,880 | 1,260 | 3,545 | 210,942 |
| December | 10,700 | 2,760 | 5,227 | 321,382 |
| The year | 29,300 | 760 | 4,780 | 3,470,222 |

## RIO GRANDE BELOW MOUTH OF DEVILS RIVER, TEXAS.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is alongside the Southern Pacific Railroad track, about a mile below the mouth of Devils River and about 480 miles below El Paso.

The river is nearly straight for 1 mile above and the same distance below the station. The right bank is alluvial deposit, overflowing in extreme high water for a distance of some 500 feet back from the river. The left bank is a loose rock fill along which runs the Southern Pacific Railroad. The bed is rock for a short distance from the left bank; the rest is shifting sand and gravel.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire.

The gage is an inclined scantling spiked to posts set in the ground. The highest flood on record showed watermarks of 36.5 feet on gage; it occurred April 6, 1900, about two weeks before this gage was established. The range between high and low water is about 33 feet. The bench mark is a cross cut on top of the coping stone of a culvert near the gage; elevation, 36.98 feet above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter and the gage reader is John Harrison.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 364-365; 66, p 80; 84, p 162; 99, p 345; 132, p 84.
Discharge: WS 50, p 365; 66, p 80; 84, p 162; 99, pp 345-347; 132, pp 84-85.
Discharge, mean daily: WS 132, p 87.
Discharge, monthly: Ann 22, iv, p 357; WS 75, p 161; 84, p 163; 99, p 348; 132, p 88.
Gage heights: WS 50, p 365; 66, p 81; 84, p 163; 99, pp 347-348; 132, p 86.

*Discharge measurements of Rio Grande below mouth of Devils River, Texas, in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 4 | E. E. Winter | 1,267 | 1.99 | 3.9 | 2,524 |
| January 10 | do | 1,225 | 1.99 | 3.8 | 2,439 |
| January 13 | do | 1,185 | 1.91 | 3.7 | 2,264 |
| January 18 | do | 1,171 | 1.87 | 3.6 | 2,187 |
| January 21 | do | 1,155 | 1.82 | 3.6 | 2,104 |
| January 26 | do | 1,218 | 1.98 | 3.9 | 2,411 |
| January 31 | do | 1,175 | 1.89 | 3.7 | 2,225 |
| February 4 | do | 1,160 | 1.78 | 3.6 | 2,060 |
| February 9 | do | 1,190 | 1.78 | 3.7 | 2,123 |
| February 13 | do | 1,150 | 1.74 | 3.6 | 2,005 |
| February 17 | do | 1,342 | 1.64 | 3.6 | 2,197 |
| February 22 | do | 1,392 | 1.72 | 3.85 | 2,401 |
| February 28 | do | 1,566 | 2.23 | 4.4 | 3,485 |
| March 7 | do | 1,607 | 2.17 | 4.6 | 3,487 |
| March 14 | do | 1,746 | 2.51 | 5.3 | 4,378 |
| March 18 | do | 1,887 | 3.56 | 6.0 | 6,715 |
| March 22 | do | 1,928 | 3.73 | 6.2 | 7,193 |
| March 26 | do | 1,703 | 2.64 | 5.6 | 4,494 |
| March 31 | do | 1,602 | 2.29 | 5.1 | 3,671 |
| April 6 | do | 1,570 | 2.58 | 4.7 | 4,050 |
| April 10 | do | 1,531 | 2.87 | 4.5 | 4,400 |
| April 14 | do | 1,468 | 2.84 | 4.4 | 4,167 |
| April 19 | do | 1,385 | 2.28 | 4.0 | 3,152 |
| April 22 | do | 1,402 | 2.41 | 4.25 | 3,382 |
| April 26 | do | 1,790 | 2.84 | 5.5 | 5,078 |

*Discharge measurements of Rio Grande below mouth of Devils River, etc.*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 30 | E. E. Winter | 2,170 | 3.24 | 6.7 | 7,024 |
| May 5 | do | 1,741 | 3.03 | 5.7 | 5,274 |
| May 9 | do | 1,930 | 3.15 | 5.9 | 6,086 |
| May 13 | do | 1,774 | 3.04 | 5.7 | 5,387 |
| May 18 | do | 1,977 | 3.38 | 6.0 | 6,690 |
| May 22 | do | 2,122 | 3.11 | 5.9 | 6,603 |
| May 26 | do | 2,203 | 3.27 | 6.2 | 7,214 |
| May 31 | do | 2,260 | 3.68 | 6.4 | 8,306 |
| June 6 | do | 2,386 | 3.44 | 6.6 | 8,202 |
| June 10 | do | 2,717 | 4.59 | 7.5 | 12,475 |
| June 15 | do | 3,101 | 5.08 | 9.4 | 15,764 |
| June 19 | do | 3,410 | 6.12 | 9.5 | 20,879 |
| June 23 | do | 3,336 | 6.16 | 9.0 | 20,564 |
| June 27 | do | 3,034 | 5.15 | 8.4 | 15,628 |
| June 29 | do | 10,582 | 8.05 | 21.9 | 85,148 |
| July 6 | do | 2,321 | 3.94 | 6.7 | 9,144 |
| July 12 | do | 2,062 | 3.08 | 5.9 | 6,343 |
| July 17 | do | 1,575 | 2.44 | 4.7 | 3,844 |
| July 22 | do | 2,223 | 3.68 | 6.5 | 8,179 |
| July 26 | do | 2,285 | 4.09 | 7.05 | 9,344 |
| July 31 | do | 3,088 | 5.12 | 8.6 | 15,796 |
| August 8 | do | 2,610 | 4.03 | 6.9 | 10,525 |
| August 12 | do | 2,550 | 4.40 | 7.0 | 11,210 |
| August 17 | do | 3,063 | 5.14 | 8.6 | 15,746 |
| August 23 | do | 2,700 | 4.69 | 7.5 | 12,660 |
| August 26 | do | 2,697 | 4.60 | 7.3 | 12,419 |
| August 31 | do | 2,279 | 4.08 | 6.2 | 9,287 |
| September 5 | do | 1,736 | 3.03 | 5.2 | 5,254 |
| September 12 | do | 2,930 | 4.46 | 8.15 | 13,060 |
| September 18 | do | 2,373 | 3.91 | 6.9 | 9,282 |
| September 24 | do | 1,769 | 3.40 | 5.4 | 6,022 |
| September 27 | do | 3,423 | 5.84 | 9.95 | 20,000 |
| September 30 | do | 2,682 | 5.08 | 7.95 | 13,619 |
| October 5 | do | 2,568 | 4.59 | 7.55 | 11,785 |
| October 9 | do | 2,502 | 4.41 | 7.25 | 11,027 |
| October 13 | do | 2,178 | 4.04 | 6.5 | 8,807 |
| October 18 | do | 1,715 | 3.36 | 5.1 | 5,770 |
| October 21 | do | 1,388 | 3.19 | 4.8 | 4,426 |
| October 26 | do | 1,268 | 3.06 | 4.4 | 3,875 |
| October 31 | do | 1,169 | 2.88 | 4.1 | 3,366 |
| November 5 | do | 1,258 | 2.35 | 4.0 | 2,951 |
| November 8 | do | 1,214 | 2.19 | 3.95 | 2,659 |
| November 12 | do | 1,256 | 2.40 | 4.0 | 3,013 |
| November 15 | do | 2,826 | 5.54 | 8.45 | 15,664 |
| November 20 | do | 2,181 | 4.77 | 6.8 | 10,397 |
| November 24 | do | 1,905 | 4.34 | 5.8 | 8,265 |
| November 29 | do | 1,442 | 3.81 | 4.9 | 5,489 |
| December 6 | H. F. Collins | 1,879 | 5.18 | 6.3 | 9,728 |
| December 11 | do | 1,578 | 4.04 | 6.1 | 6,371 |
| December 15 | do | 1,449 | 3.83 | 5.2 | 5,543 |
| December 19 | do | 1,426 | 3.77 | 5.3 | 5,371 |
| December 24 | do | 2,360 | 5.70 | 7.45 | 13,442 |
| December 27 | do | 1,884 | 4.79 | 6.2 | 9,027 |

*Daily gage height, in feet, of Rio Grande below mouth of Devils River, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.2 | 3.7 | 4.25 | 8.0 | 6.25 | 6.35 | 10.7 | 7.85 | 5.65 | 7.2 | 4.1 | 4.65 |
| 2 | 4.0 | 3.65 | 4.35 | 7.1 | 5.85 | 6.7 | 10.7 | 7.6 | 5.5 | 7.75 | 4.1 | 4.6 |
| 3 | 3.95 | 3.6 | 4.4 | 5.5 | 5.75 | 6.5 | 10.1 | 7.6 | 5.5 | 9.0 | 4.15 | 4.5 |
| 4 | 3.9 | 3.55 | 4.4 | 5.05 | 5.7 | 6.55 | 7.25 | 7.35 | 5.4 | 8.45 | 4.1 | 4.5 |
| 5 | 3.9 | 3.5 | 4.45 | 4.85 | 5.7 | 6.6 | 7.15 | 7.0 | 5.3 | 7.65 | 4.0 | 5.95 |
| 6 | 3.9 | 3.55 | 4.75 | 4.65 | 5.8 | 6.65 | 6.75 | 6.95 | 5.1 | 6.95 | 4.05 | 6.4 |
| 7 | 3.85 | 3.65 | 4.7 | 4.55 | 5.85 | 6.85 | 6.35 | 6.9 | 5.0 | 7.0 | 3.9 | 6.65 |
| 8 | 3.85 | 3.65 | 5.35 | 4.5 | 5.9 | 7.1 | 6.3 | 7.0 | 5.2 | 7.7 | 3.95 | 6.6 |
| 9 | 3.8 | 3.7 | 5.65 | 4.5 | 5.9 | 7.55 | 6.2 | 7.1 | 5.6 | 7.25 | 3.95 | 6.15 |
| 10 | 3.8 | 3.7 | 5.95 | 4.5 | 7.15 | 7.5 | 5.8 | 7.3 | 7.0 | 7.05 | 4.0 | 6.15 |
| 11 | 3.75 | 3.7 | 5.0 | 4.5 | 5.8 | 7.55 | 5.3 | 7.5 | 9.7 | 7.0 | 4.05 | 6.05 |
| 12 | 3.75 | 3.7 | 4.9 | 4.5 | 5.7 | 8.1 | 5.5 | 6.85 | 8.35 | 6.8 | 4.0 | 5.55 |
| 13 | 3.7 | 3.7 | 5.3 | 4.5 | 5.7 | 8.65 | 4.95 | 8.95 | 7.6 | 6.4 | 4.1 | 5.65 |
| 14 | 3.7 | 3.65 | 5.35 | 4.4 | 5.95 | 9.0 | 4.9 | 8.65 | 7.95 | 6.0 | 5.55 | 5.35 |
| 15 | 3.7 | 3.65 | 6.3 | 4.3 | 6.1 | 9.45 | 4.75 | 7.55 | 7.4 | 5.9 | 8.3 | 5.25 |
| 16 | 3.65 | 3.65 | 6.2 | 4.3 | 6.05 | 9.7 | 4.65 | 7.75 | 7.2 | 5.3 | 7.1 | 5.45 |
| 17 | 3.6 | 3.6 | 5.9 | 4.25 | 5.95 | 9.8 | 4.7 | 8.55 | 6.9 | 5.1 | 6.6 | 5.9 |
| 18 | 3.6 | 3.6 | 5.95 | 4.15 | 5.95 | 9.6 | 5.4 | 8.25 | 6.9 | 5.05 | 6.7 | 5.6 |
| 19 | 3.6 | 3.6 | 5.9 | 4.0 | 5.9 | 9.55 | 5.25 | 8.3 | 6.95 | 4.95 | 6.75 | 5.8 |
| 20 | 3.6 | 3.6 | 5.9 | 4.0 | 5.9 | 9.7 | 6.5 | 8.75 | 6.75 | 4.95 | 6.75 | 7.35 |
| 21 | 3.6 | 3.65 | 6.0 | 4.0 | 5.9 | 9.7 | 6.2 | 9.1 | 5.85 | 4.85 | 6.65 | 7.25 |
| 22 | 3.6 | 4.0 | 6.15 | 4.25 | 5.9 | 9.2 | 6.5 | 8.45 | 5.5 | 4.75 | 6.55 | 7.0 |
| 23 | 3.75 | 4.4 | 6.05 | 4.45 | 5.95 | 8.8 | 6.9 | 7.3 | 5.5 | 4.7 | 6.1 | 6.65 |
| 24 | 3.85 | 4.4 | 5.85 | 7.7 | 6.15 | 8.6 | 7.0 | 6.95 | 5.35 | 4.6 | 5.65 | 7.1 |
| 25 | 3.9 | 4.4 | 5.65 | 5.95 | 7.25 | 8.6 | 7.9 | 7.1 | 6.65 | 4.5 | 5.35 | 7.15 |
| 26 | 3.9 | 4.4 | 5.55 | 5.3 | 6.3 | 8.55 | 7.1 | 7.45 | 8.75 | 4.45 | 5.25 | 6.6 |
| 27 | 3.9 | 4.4 | 5.45 | 4.95 | 6.1 | 8.4 | 7.5 | 7.7 | 10.2 | 4.35 | 5.15 | 6.15 |
| 28 | 3.85 | 4.4 | 5.4 | 4.9 | 6.05 | 10.3 | 7.8 | 7.35 | 10.7 | 4.25 | 5.0 | 5.95 |
| 29 | 3.8 | ....... | 5.35 | 5.0 | 6.1 | 21.1 | 8.5 | 6.9 | 8.7 | 4.2 | 4.95 | 5.75 |
| 30 | 3.75 | ....... | 5.15 | 6.7 | 6.1 | 9.65 | 8.7 | 6.35 | 7.8 | 4.15 | 4.8 | 5.55 |
| 31 | 3.7 | ....... | 5.05 | ....... | 6.3 | ....... | 8.5 | 6.1 | ....... | 4.1 | ....... | 5.4 |

*Daily discharge, in second-feet, of Rio Grande below mouth of Devils River, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2,730 | 2,220 | 3,240 | 10,900 | 6,230 | 8,040 | 29,140 | 13,470 | 7,060 | 10,900 | 3,320 | 4,750 |
| 2 | 2,590 | 2,140 | 3,340 | 8,200 | 5,530 | 8,970 | 29,140 | 12,700 | 6,460 | 12,700 | 3,280 | 4,580 |
| 3 | 2,550 | 2,060 | 3,370 | 5,400 | 5,360 | 8,250 | 26,140 | 12,700 | 6,460 | 18,450 | 3,330 | 4.280 |
| 4 | [a]2,520 | [a]2,030 | 3,330 | 4,630 | 5,270 | 8,280 | 11,890 | 11,920 | 6,050 | 15,920 | 3,190 | 4,280 |
| 5 | 2,520 | 2,000 | 3,360 | 4,290 | [a]5,270 | 8,310 | 11,390 | 10,840 | [a]5,650 | [a]12,180 | [a]2,950 | 8,670 |
| 6 | 2,520 | 2,030 | 3,740 | [a]3,950 | 5,600 | [a]8,430 | [a]9,390 | 10,680 | 4,950 | 10,280 | 2,990 | [a]10,030 |
| 7 | 2,480 | 2,090 | [a]3,630 | 3,940 | 5,800 | 9,380 | 7,910 | 10,530 | 4,750 | 10,400 | 2,630 | 10,230 |
| 8 | 2,480 | 2,090 | 4,700 | 4,030 | 6,010 | 10,570 | 7,740 | [a]10,830 | 5,150 | 12,380 | [a]2,660 | 9,530 |
| 9 | 2,440 | [a]2,120 | 5,300 | 4,220 | [a]6,090 | 12,710 | 7,390 | 11,130 | 5,950 | [a]11,030 | 2,720 | 7,630 |
| 10 | [a]2,440 | 2,120 | 5,900 | [a]4,400 | 9,010 | [a]12,470 | 6,130 | 11,730 | 9,450 | 10,440 | 2,880 | 7,080 |
| 11 | 2,350 | 2,120 | 4,000 | 4,400 | 5,640 | 12,550 | 5,080 | 12,330 | 20,600 | 10,290 | 3,040 | [a]6,220 |
| 12 | 2,350 | 2,120 | 3,870 | 4,400 | 5,390 | 13.500 | [a]5,500 | [a]10,790 | [a]13,860 | 9,700 | [a]3,010 | 5,190 |
| 13 | [a]2,260 | [a]2,120 | 4,380 | 4,400 | [a]5,390 | 14,460 | 4,350 | 17,150 | 11,400 | [a]8,590 | 3,210 | 5,960 |
| 14 | 2,260 | 2,110 | [a]4,500 | [a]4,170 | 6,120 | 15,060 | 4,250 | 15,950 | 12,450 | 7,720 | 6,960 | 5.530 |
| 15 | 2,260 | 2,160 | 6,940 | 3,920 | 6,610 | [a]15,960 | 3,940 | 12,770 | 10,800 | 7,510 | [a]15,210 | [a]5,690 |
| 16 | 2,220 | 2,210 | 6,870 | 3,920 | 6,600 | 18,140 | 3,730 | 13,330 | 10,200 | 6,200 | 11,340 | 6.170 |
| 17 | 2,190 | [a]2,200 | 6,310 | 3,790 | 6,460 | 19,720 | [a]3,840 | [a]15,600 | 9,280 | 5,770 | 9,960 | 7,400 |
| 18 | [a]2,190 | 2,200 | [a]6,600 | 3,540 | [a]6,570 | 20,100 | 5,530 | 14,770 | [a]9,280 | [a]5,670 | 10,180 | 6,380 |
| 19 | 2,160 | 2,200 | 6,480 | [a]3,150 | 6,600 | [a]21,080 | 5,170 | 14,910 | 9,430 | 5,230 | 10,290 | 7,250 |
| 20 | 2,130 | 2,200 | 6,480 | 3.150 | 6,600 | 22,100 | 8,180 | 16,350 | 8,960 | 4,980 | [a]10,290 | 13.060 |
| 21 | [a]2,100 | 2,240 | 6,720 | 3,150 | [a]6,600 | 22,520 | 7,460 | 17,750 | 7,000 | [a]4,530 | 10,070 | 12.680 |
| 22 | 2,100 | [a]2,690 | [a]7,080 | [a]3,380 | 6,600 | 20,940 | [a]8,180 | 15,330 | 6,240 | 4,360 | 9,860 | 11.750 |
| 23 | 2,250 | 3,490 | 6,520 | 3,650 | 6,700 | [a]19,760 | 9,030 | [a]12,100 | 6,240 | 4,290 | 8,900 | 10,450 |
| 24 | 2,350 | 3,490 | 5,720 | 10,000 | 7,110 | 18,330 | 9,240 | 11,420 | [a]5,920 | 4,150 | [a]7,800 | [a]12,130 |
| 25 | 2,410 | 3,490 | 4,930 | 5,980 | 9,860 | 17,700 | 12,740 | 11,850 | 9,870 | 4,010 | 6,870 | 12,380 |
| 26 | [a]2,410 | 3,490 | [a]4,410 | [a]4,800 | [a]7,460 | 16,860 | [a]9,550 | [a]12,850 | 16,340 | [a]3,940 | 6,560 | 10,440 |
| 27 | 2,410 | 3,490 | 4,240 | 4,310 | 6,960 | [a]15,630 | 11,220 | 13,560 | [a]21,000 | 3,790 | 6,250 | [a]8,860 |
| 28 | 2,360 | [a]3,490 | 4,160 | 4,240 | 6,840 | 25,100 | 12,460 | 12,560 | 23,500 | 3,620 | 5,790 | 8,190 |
| 29 | 2,310 | ....... | 4,080 | 4,380 | 6,960 | [a]80,350 | 15,380 | 11,280 | 16,020 | 3,540 | [a]5,640 | 7,520 |
| 30 | 2,260 | ....... | 3,750 | [a]7,020 | 6,960 | 21,900 | 16,210 | 9,720 | [a]13,140 | 3,450 | 5,290 | 6.850 |
| 31 | [a]2,220 | ....... | [a]3,590 | ....... | [a]7,760 | ....... | [a]15,390 | [a]9,000 | ....... | [a]3,370 | ....... | 6,350 |

[a] Meter measurements.

*Estimated monthly discharge of Rio Grande below mouth of Devils River, Tex., for 1905.*

| Month. | Discharge in second-feet. Maximum. | Minimum. | Mean. | Total in acre-feet. |
|---|---|---|---|---|
| January | 2,730 | 2,100 | 2,349 | 144,436 |
| February | 3,490 | 2,000 | 2,443 | 135,689 |
| March | 7,080 | 3,240 | 4,888 | 300,575 |
| April | 10,900 | 3,150 | 4,790 | 285,045 |
| May | 9,860 | 5,270 | 6,515 | 400,582 |
| June | 80,350 | 8,040 | 17,572 | 1,045,626 |
| July | 29,140 | 3,730 | 10,409 | 640,046 |
| August | 17,750 | 9,000 | 12,835 | 789,223 |
| September | 23,500 | 4,750 | 10,115 | 601,904 |
| October | 18,450 | 3,370 | 7,722 | 474,823 |
| November | 15.210 | 2,630 | 6,216 | 369,858 |
| December | 13,060 | 4,280 | 7,984 | 490,889 |
| The year | 80,350 | 2,000 | 7,820 | 5,678,696 |

## RIO GRANDE AT EAGLE PASS, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is a half mile above the highway bridge between Eagle Pass, Tex., and Ciudad Porfirio Diaz, Mexico, and about 540 miles below El Paso.

The river is practically straight for 1 mile above the station. Below it curves slowly to the right for about half a mile and then swings as slowly to the left. The right bank is alluvial deposit with a bottom back of it about 1,500 feet wide, which begins to overflow at gage height 22 feet. The left bank is shale rock rising abruptly from the river. The bed of the stream is shifting sand. At low water the depth is considerable and the velocity slow.

Discharge measurements are made by means of a cable, car, tagged wire, and guy wire. The initial point for soundings is the pole supporting the cable on the left bank.

The gage up to 10.5 feet is a vertical staff bolted to a shale cliff. Above 10.5 feet, it is inclined and spiked to posts set in the shale. The highest recorded flood reached gage height 34.6 feet, and occurred at midnight, June 29, 1905. The range between high and low water is 33 feet. The bench mark is the top of a nail driven into the shale at the gage; elevation, 10.40 feet above the datum of the gage.

The observations during 1905 were made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is J. K. Wilson, and the gage reader Robert Boubel.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 365–366; 66, p 81; 84, p 158; 99, p 341; 132, p 88.
Discharge: WS 50, p 366; 66, pp 81–82; 84, pp 158–159; 99, pp 341–344; 132, pp 88–91.
Discharge, mean daily: WS 132, p 93.
Discharge, monthly: Ann 22, iv, p 357; WS 75, p 162; 84, p 160; 99, p 345; 132, p 94.
Gage heights: WS 50, p 366; 66, p 82; 99, p 344; 132, p 92.
Hydrograph: WS 75, p 163.

*Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | J. K. Wilson | 2,609 | 1.68 | 3.3 | 4,373 |
| January 7 | do | 2,557 | 1.58 | 3.1 | 4,048 |
| January 11 | do | 2,464 | 1.31 | 3.1 | 3,221 |
| January 14 | do | 2,498 | 1.26 | 3.1 | 3,158 |
| January 17 | do | 2,464 | 1.37 | 3.0 | 3,370 |
| January 21 | do | 2,479 | 1.38 | 2.8 | 3,416 |
| January 24 | do | 2,467 | 1.32 | 2.8 | 3,259 |
| January 28 | do | 2,473 | 1.40 | 2.95 | 3,462 |
| January 31 | do | 2,542 | 1.33 | 3.1 | 3,390 |
| February 3 | do | 2,530 | 1.28 | 3.0 | 3,229 |
| February 7 | do | 2,472 | 1.27 | 2.7 | 3,131 |
| February 11 | do | 2,444 | 1.41 | 2.9 | 3,452 |
| February 14 | do | 2,499 | 1.30 | 2.8 | 3,254 |
| February 17 | do | 2,450 | 1.32 | 2.8 | 3,239 |
| February 21 | do | 2,484 | 1.29 | 2.8 | 3,213 |
| February 24 | do | 2,529 | 1.59 | 3.25 | 4,024 |
| February 28 | do | 2,551 | 1.62 | 3.2 | 4,126 |
| March 4 | do | 2,548 | 1.63 | 3.2 | 4,143 |
| March 6 | do | 2,657 | 1.69 | 3.4 | 4,498 |
| March 9 | do | 2,947 | 2.42 | 4.1 | 7,126 |
| March 10 | do | 3,729 | 4.25 | 5.4 | 15,851 |
| March 14 | do | 2,931 | 2.53 | 4.0 | 7,406 |

*Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 16 | J. K. Wilson | 3,600 | 4.15 | 5.1 | 14,945 |
| March 19 | do | 2,965 | 3.00 | 4.6 | 8,902 |
| March 23 | do | 2,982 | 3.09 | 4.7 | 9,226 |
| March 27 | do | 2,893 | 2.37 | 4.15 | 6,850 |
| March 31 | do | 2,823 | 2,38 | 4.0 | 6,715 |
| April 1 | do | 3,695 | 3.66 | 5.5 | 13,534 |
| April 2 | do | 4,270 | 6.34 | 6.75 | 27,061 |
| April 6 | do | 2,955 | 1.96 | 3.8 | 5,792 |
| April 10 | do | 2,611 | 1.99 | 3.6 | 5,207 |
| April 13 | do | 2,576 | 2.04 | 3.7 | 5,250 |
| April 17 | do | 2,535 | 1.98 | 3.5 | 5,010 |
| April 20 | do | 2,483 | 1.80 | 3.35 | 4,478 |
| April 24 | do | 3,817 | 4.82 | 6.4 | 18,395 |
| April 27 | do | 2,622 | 2.43 | 4.0 | 6,370 |
| April 30 | do | 2,974 | 2.79 | 4.25 | 8,298 |
| May 4 | do | 2,827 | 2.99 | 4.4 | 8,447 |
| May 8 | do | 2,791 | 2.93 | 4.5 | 8,188 |
| May 11 | do | 2,767 | 2.85 | 4.5 | 7,895 |
| May 15 | do | 3,119 | 3.20 | 4.9 | 9,994 |
| May 18 | do | 2,758 | 3.02 | 4.4 | 8,341 |
| May 21 | do | 3,038 | 3.26 | 4.5 | 9,905 |
| May 25 | do | 3,109 | 3.66 | 5.05 | 11,370 |
| May 28 | do | 3,062 | 3.97 | 5.25 | 12,150 |
| May 31 | do | 3,093 | 3.74 | 4.8 | 11,580 |
| June 3 | do | 3,116 | 3.40 | 5.1 | 10,593 |
| June 7 | do | 3,389 | 3.36 | 5.05 | 11,395 |
| June 10 | do | 3,573 | 4.48 | 5.95 | 16,014 |
| June 13 | do | 3,727 | 4.95 | 6.35 | 18,445 |
| June 17 | do | 4,326 | 5.54 | 7.4 | 23,980 |
| June 20 | do | 4,255 | 5.13 | 7.2 | 21,834 |
| June 23 | do | 4,206 | 5.01 | 7.1 | 21,090 |
| June 27 | do | 4,269 | 4.58 | 6.9 | 19,559 |
| July 10 | do | 4,533 | 2.76 | 4.8 | 12,529 |
| July 14 | do | 3,918 | 1.89 | 4.0 | 7,418 |
| July 17 | do | 3,837 | 1.88 | 4.0 | 7,214 |
| July 21 | do | 4,183 | 2.65 | 5.0 | 11,082 |
| July 25 | do | 3,977 | 2.08 | 4.3 | 8,261 |
| July 28 | do | 4,061 | 2.91 | 5.25 | 11,815 |
| July 31 | do | 4,401 | 3.99 | 6.7 | 17,575 |
| August 4 | do | 3,874 | 3.73 | 6.0 | 14,458 |
| August 7 | do | 4,052 | 3.52 | 5.4 | 14,247 |
| August 10 | do | 3,816 | 3.53 | 5.6 | 13,488 |
| August 16 | do | 3,773 | 3.95 | 5.7 | 14,915 |
| August 19 | do | 4,011 | 3.99 | 6.0 | 16,000 |
| August 23 | do | 4,052 | 4.20 | 6.0 | 17,014 |
| August 26 | do | 3,723 | 3.63 | 5.5 | 13,512 |
| August 29 | do | 3,665 | 3.71 | 5.4 | 13,614 |
| August 31 | do | 3,607 | 2.99 | 4.8 | 10,782 |
| September 4 | do | 3,371 | 2.47 | 4.4 | 8,329 |
| September 7 | do | 3,099 | 2.14 | 3.8 | 6,646 |
| September 11 | Pedro Rosales | 3,916 | 3.89 | 5.9 | 15,228 |
| September 14 | do | 3,663 | 3.92 | 5.7 | 14,344 |
| September 19 | do | 3,671 | 3.45 | 5.55 | 12,683 |

*Discharge measurements of Rio Grande at Eagle Pass, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 22 | Pedro Rosales | 3,251 | 2.77 | 4.55 | 9,008 |
| September 25 | do | 2,904 | 2.75 | 4.0 | 7,991 |
| September 28 | do | 4,610 | 6.69 | 7.85 | 30,834 |
| September 29 | do | 4,980 | 6.97 | 8.3 | 34,695 |
| October 2 | do | 3,490 | 4.16 | 5.9 | 14,515 |
| October 5 | do | 4,009 | 4.53 | 6.35 | 18,172 |
| October 9 | J. K. Wilson | 3,939 | 4.75 | 6.3 | 18,728 |
| October 17 | do | 2,733 | 2.55 | 3.9 | 6,973 |
| October 20 | do | 2,458 | 2.17 | 3.5 | 5,344 |
| October 24 | do | 2,377 | 2.00 | 3.3 | 4,752 |
| October 27 | do | 2,275 | 1.97 | 3.2 | 4,484 |
| October 31 | do | 2,252 | 1.99 | 3.0 | 4,472 |
| November 4 | do | 2,436 | 2.27 | 3.3 | 5,526 |
| November 7 | do | 2,310 | 2.00 | 2.9 | 4,622 |
| November 11 | do | 2,226 | 1.85 | 2.7 | 4,127 |
| November 15 | do | 3,254 | 3.70 | 5.0 | 12,039 |
| November 18 | do | 2,940 | 4.10 | 4.85 | 12,041 |
| November 22 | do | 3,954 | 3.73 | 4.9 | 14,756 |
| November 25 | do | 2,548 | 2.66 | 4.2 | 6,768 |
| November 28 | do | 2,420 | 2.57 | 3.7 | 6,216 |
| November 30 | do | 2,321 | 2.33 | 3.6 | 5,419 |
| December 4 | do | 2,510 | 2.17 | 3.3 | 5,438 |
| December 8 | do | 2,609 | 2.87 | 4.3 | 7,498 |
| December 11 | do | 2,629 | 2.39 | 3.8 | 6,273 |
| December 14 | do | 2,371 | 2.44 | 3.7 | 5,785 |
| December 18 | do | 2,367 | 2.36 | 3.6 | 5,584 |
| December 21 | do | 3,152 | 4.07 | 4.8 | 12,817 |
| December 26 | do | 4,011 | 4.05 | 4.95 | 16,242 |
| December 28 | do | 2,492 | 3.10 | 4.4 | 7,718 |
| December 31 | do | 2,631 | 2.40 | 3.85 | 6,327 |

*Daily gage height, in feet, of Rio Grande at Eagle Pass, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 3.0 | 3.2 | 5.8 | 4.65 | 5.0 | 14.0 | 6.45 | 4.45 | 5.8 | 3.0 | 3.5 |
| 2 | 3.3 | 3.0 | 3.2 | 7.1 | 4.5 | 5.05 | 13.0 | 6.05 | 4.25 | 5.9 | 3.0 | 3.4 |
| 3 | 3.3 | 3.0 | 3.1 | 4.65 | 4.4 | 5.1 | 11.0 | 6.0 | 4.4 | 6.3 | 3.35 | 3.3 |
| 4 | 3.2 | 2.8 | 3.2 | 4.0 | 4.35 | 5.0 | 10.2 | 5.95 | 4.35 | 6.8 | 3.3 | 3.35 |
| 5 | 3.2 | 2.8 | 3.4 | 3.8 | 4.5 | 4.9 | 6.9 | 5.6 | 4.0 | 6.2 | 3.15 | 3.5 |
| 6 | 3.1 | 2.75 | 3.4 | 3.8 | 4.6 | 4.95 | 6.3 | 5.45 | 3.9 | 5.5 | 2.95 | 4.6 |
| 7 | 3.1 | 2.7 | 3.5 | 3.8 | 4.45 | 5.1 | 6.2 | 5.35 | 3.75 | 5.3 | 2.85 | 4.45 |
| 8 | 3.1 | 2.7 | 3.95 | 3.8 | 4.5 | 5.3 | 6.15 | 5.4 | 3.75 | 5.85 | 2.85 | 4.3 |
| 9 | 3.1 | 2.9 | 4.05 | 3.7 | 4.6 | 5.8 | 5.95 | 5.45 | 4.15 | 6.3 | 2.8 | 4.2 |
| 10 | 3.1 | 2.9 | 5.45 | 3.6 | 5.4 | 6.0 | 4.85 | 5.65 | 4.45 | 5.7 | 2.7 | 3.85 |
| 11 | 3.1 | 2.9 | 4.8 | 3.8 | 4.6 | 5.85 | 4.55 | 5.55 | 5.9 | 5.1 | 2.7 | 3.8 |
| 12 | 3.1 | 2.9 | 4.2 | 3.85 | 4.4 | 5.95 | 4.4 | 5.4 | 7.2 | 4.8 | 2.85 | 3.75 |
| 13 | 3.1 | 2.9 | 4.0 | 3.7 | 4.3 | 6.35 | 4.15 | 5.7 | 5.65 | 4.55 | 2,9 | 3.8 |
| 14 | 3.1 | 2.8 | 4.0 | 3.7 | 4.4 | 6.7 | 3.95 | 6.5 | 5.8 | 4.45 | 3.75 | 3.7 |
| 15 | 3.0 | 2.8 | 4.2 | 3.6 | 4.9 | 6.95 | 3.75 | 6.25 | 5.95 | 4.25 | 4.55 | 3.6 |
| 16 | 3.0 | 2.8 | 5.5 | 3.55 | 4.7 | 7.2 | 3.55 | 5.7 | 5.45 | 4.1 | 5.4 | 3.6 |
| 17 | 3.0 | 2.8 | 4.6 | 3.5 | 4.4 | 7.4 | 4.0 | 5.9 | 5.25 | 3.85 | 4.95 | 3.6 |
| 18 | 2.9 | 2.8 | 4.6 | 3.4 | 4.4 | 7.4 | 4.0 | 6.25 | 5.3 | 3.65 | 4.75 | 3.55 |
| 19 | 2.9 | 2.8 | 4.6 | 3.3 | 4.3 | 7.4 | 3.95 | 6.0 | 5.65 | 3.6 | 4.95 | 3.45 |
| 20 | 2.8 | 2.8 | 4.5 | 3.3 | 4.55 | 7.2 | 4.8 | 6.15 | 5.4 | 3.55 | 4.95 | 4.6 |
| 21 | 2.8 | 2.8 | 4.65 | 3.35 | 4.5 | 7.45 | 5.0 | 6.65 | 4.85 | 3.7 | 4.85 | 4.85 |
| 22 | 2.8 | 2.8 | 4.7 | 3.55 | 4.7 | 7.2 | 4.7 | 7.0 | 4.55 | 3.5 | 4.9 | 4.8 |
| 23 | 2.8 | 3.0 | 4.65 | 3.5 | 4.65 | 7.1 | 5.3 | 5.95 | 4.3 | 3.4 | 4.65 | 4.7 |
| 24 | 2.8 | 3.15 | 4.5 | 5.35 | 5.15 | 7.0 | 4.5 | 5.5 | 4.2 | 3.35 | 4.35 | 4.65 |
| 25 | 2.75 | 3.4 | 4.4 | 4.8 | 5.65 | 7.0 | 4.9 | 5.35 | 4.0 | 3.3 | 4.15 | 5.3 |
| 26 | 2.7 | 3.4 | 4.3 | 4.55 | 6.9 | 6.95 | 6.7 | 5.55 | 5.95 | 3.2 | 4.0 | 4.95 |
| 27 | 2.7 | 3.3 | 4.15 | 4.0 | 5.35 | 6.9 | 5.85 | 5.8 | 7.15 | 3.2 | 3.75 | 4.65 |
| 28 | 2.95 | 3.2 | 4.2 | 4.4 | 5.6 | 6.45 | 5.25 | 5.75 | 7.8 | 3.15 | 3.7 | 4.35 |
| 29 | 3.2 | ....... | 4.1 | 4.05 | 5.0 | 16.8 | 5.65 | 5.35 | 8.1 | 3.1 | 3.6 | 4.2 |
| 30 | 3.1 | ....... | 4.05 | 4.65 | 4.8 | 25.4 | 6.3 | 4.95 | 6.3 | 3.0 | 3.55 | 4.3 |
| 31 | 3.05 | ....... | 4.0 | ....... | 4.85 | ....... | 6.7 | 4.75 | ....... | 3.05 | ....... | 3.85 |

*Daily discharge, in second-feet, of Rio Grande at Eagle Pass, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4,290 | 3,230 | 4,130 | a15,200 | 9,450 | 11,650 | 75,500 | 16,460 | 8,640 | 14,010 | 4,470 | 5,350 |
| 2 | 4,330 | 3,230 | 4,130 | a29,100 | 8,850 | 11,120 | 66,500 | 14,680 | 7,880 | a14,510 | 4,470 | 5,280 |
| 3 | a4,370 | a3,230 | 3,950 | 9,000 | 8,450 | a10,590 | 50,500 | 14,460 | 8,330 | 16,980 | 5,700 | 5,210 |
| 4 | 4,210 | 3,160 | a4,140 | 6,390 | a8,250 | 10,440 | 44,900 | a14,210 | a8,190 | 19,950 | a5,530 | a5,540 |
| 5 | 4,210 | 3,160 | 4,500 | 5,790 | 8,690 | 10,290 | 25,100 | 13,390 | 7,210 | a17,420 | 5,190 | 5,850 |
| 6 | 4,050 | 3,140 | a4,500 | a5,790 | 8,930 | 10,740 | 21,500 | 13,570 | 6,930 | 14,120 | 4,740 | 8,120 |
| 7 | a4,070 | a3,130 | 4,750 | 5,790 | 8,160 | a11,650 | 20,900 | a14,000 | a6,510 | 13,320 | a4,500 | 7,810 |
| 8 | 3,840 | 3,130 | 6,530 | 5,790 | a8,190 | 12,680 | 20,600 | 13,660 | 6,510 | 16,270 | 4,500 | a7,500 |
| 9 | 3,630 | 3,450 | a6,930 | 5,500 | 8,490 | 15,240 | 19,400 | 13,330 | 8,080 | a18,730 | 4,370 | 7,250 |
| 10 | 3,420 | 3,450 | a16,050 | a5,210 | 12,500 | a16,320 | a12,830 | a13,740 | 9,310 | 15,790 | 4,130 | 6,390 |
| 11 | a3,220 | a3,450 | 10,400 | 5,600 | a8,300 | 15,410 | 10,930 | 13,390 | a15,230 | 12,850 | a4,130 | a6,270 |
| 12 | 3,200 | 3,450 | 8,000 | 5,700 | 7,500 | 16,010 | 9,970 | 12,800 | 21,700 | 11,380 | 4,500 | 6,080 |
| 13 | 3,180 | 3,450 | 7,400 | a5,250 | 7,100 | a18,450 | 8,370 | 14,450 | 14,120 | 10,160 | 4,620 | 6,080 |
| 14 | a3,160 | a3,250 | a7,400 | 5,250 | 7,500 | 20,300 | a7,170 | 18,610 | a14,840 | 9,670 | 7,170 | a5,790 |
| 15 | 3,160 | 3,250 | 8,000 | 5,130 | a9,990 | 21,620 | 6,480 | 17,510 | 15,400 | 8,690 | a10,240 | 5,590 |
| 16 | 3,260 | 3,240 | a16,550 | 5,070 | 9,330 | 22,930 | 5,710 | a14,910 | 12,720 | 7,950 | 13,840 | 5,590 |
| 17 | a3,370 | a3,240 | 8,900 | a5,010 | 8,340 | a23,980 | a7,210 | 15,640 | 11,540 | a6,770 | 12,240 | 5,580 |
| 18 | 3,330 | 3,240 | 8,900 | 4,650 | a8,340 | 23,980 | 7,210 | 17,250 | 11,610 | 5,960 | a11,640 | a5,480 |
| 19 | 3,390 | 3,230 | a8,900 | 4,300 | 8,330 | 23,980 | 7,020 | a16,000 | a12,180 | 5,750 | 13,070 | 5,280 |
| 20 | 3,350 | 3,220 | 8,580 | a4,300 | 9,720 | a21,830 | 10,300 | 17,000 | 12,130 | a5,550 | 13,700 | 11,610 |
| 21 | a3,420 | a3,210 | 9,070 | 4,480 | a9,900 | 23,690 | a11,080 | 19,750 | 10,110 | 6,140 | 13,930 | a13,020 |
| 22 | 3,360 | 3,210 | 9,230 | 5,280 | 10,440 | 21,830 | 9,870 | 21,750 | a9,010 | 5,340 | a14,760 | 12,820 |
| 23 | 3,310 | 3,570 | a9,010 | 5,080 | 10,310 | a21,090 | 12,280 | a16,660 | 8,550 | 5,050 | 12,130 | 12,420 |
| 24 | a3,260 | a3,840 | 8,360 | a12,100 | 11,770 | 20,320 | 9,060 | 13,510 | 8,370 | a4,900 | 9,100 | 12,220 |
| 25 | 3,210 | 4,320 | 7,930 | 9,570 | a14,500 | 20,320 | a10,500 | 12,760 | a7,990 | 4,750 | a6,720 | 17,300 |
| 26 | 3,160 | 4,320 | 7,500 | 8,570 | 20,900 | 19,940 | 17,600 | a13,760 | 15,500 | 4,480 | 6,550 | a16,240 |
| 27 | 3,160 | 4,220 | a6,850 | a6,370 | 12,900 | a19,560 | 14,200 | 15,210 | 25,100 | a4,480 | 6,280 | 11,590 |
| 28 | a3,460 | a4,130 | 6,970 | 7,970 | a14,000 | 17,300 | a11,810 | 15,160 | a30,400 | 4,480 | a6,220 | a7,600 |
| 29 | 3,460 | ....... | 6,840 | 6,570 | 11,830 | 166,600 | 13,400 | a13,380 | a33,000 | 4,480 | 5,670 | 7,220 |
| 30 | 3,470 | ....... | 6,780 | a9,900 | 11,580 | 238,300 | 15,980 | 11,480 | 17,200 | 4,350 | a5,270 | 7,470 |
| 31 | a3,340 | ....... | a6,720 | ....... | a11,780 | ....... | a17,580 | a10,540 | ....... | a4,600 | ....... | a6,330 |

a Meter measurements.

*Estimated monthly discharge of Rio Grande at Eagle Pass, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 4,370 | 3,160 | 3,542 | 217,805 |
| February | 4,320 | 3,130 | 3,434 | 190,711 |
| March | 16,550 | 3,950 | 7,674 | 471,868 |
| April | 29,100 | 4,300 | 7,324 | 435,788 |
| May | 20,900 | 7,100 | 10,139 | 623,445 |
| June | 238,300 | 10,290 | 29,939 | 1,781,474 |
| July | 75,500 | 5,710 | 18,757 | 1,153,309 |
| August | 21,750 | 10,540 | 14,936 | 918,387 |
| September | 33,000 | 6,510 | 12,810 | 762,228 |
| October | 19,950 | 4,350 | 9,641 | 592,820 |
| November | 14,760 | 4,130 | 7,646 | 454,968 |
| December | 17,300 | 5,210 | 8,125 | 499,597 |
| The year | 238,300 | 3,130 | 11,164 | 8,102,400 |

## RIO GRANDE NEAR LAREDO, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It was intended to measure the river from the highway bridge connecting Laredo with Nuevo Laredo, Tamaulipas, and the gage was established on the right bank just above the bridge. Measurements were kept up by the Mexican section of the Commission for five months, but the results were so conflicting that the station was abandoned. In July, 1903, a cable station was established by the Commission some 2 miles above Nuevo Laredo, crossing to the United States military reservation of Fort McIntosh, the cable landing just below the pump house. The station is about 670 miles below El Paso.

The river at the new section is nearly straight for one-half mile above and below the cable. The right bank is alluvial deposit, but is above high water. The left bank is the talus of a shale bluff going well above high water. The bed is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the right bank.

The gage is an inclined scantling fastened to posts and trees. Low water is about 1 foot on the gage. The highest flood recorded is 32.2 feet, on the night of June 30, 1905.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

*Discharge measurements of Rio Grande near Laredo, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 1 | Luis Varela | 2,183 | 1.84 | 2.3 | 4,023 |
| January 5 | do | 2,015 | 1.71 | 2.2 | 3,453 |
| January 10 | do | 1,978 | 1.69 | 2.2 | 3,339 |
| January 17 | do | 1,940 | 1.60 | 1.8 | 3,096 |
| January 21 | do | 1,942 | 1.56 | 1.7 | 3,036 |
| January 24 | do | 1,977 | 1.59 | 1.65 | 3,140 |
| January 28 | do | 1,946 | 1.52 | 1.6 | 2,956 |
| February 5 | do | 1,958 | 1.56 | 1.6 | 3,064 |
| February 11 | do | 1,831 | 1.53 | 1.5 | 2,797 |
| February 15 | do | 1,826 | 1.56 | 1.5 | 2,851 |
| February 18 | do | 1,840 | 1.60 | 1.5 | 2,944 |
| February 23 | do | 1,827 | 1.57 | 1.5 | 2,876 |
| February 27 | do | 1,857 | 1.58 | 1.5 | 2,927 |
| March 1 | do | 1,815 | 1.58 | 1.5 | 2,870 |
| March 6 | do | 2,010 | 1.69 | 2.2 | 3,404 |
| March 10 | do | 2,231 | 2.32 | 3.1 | 5,169 |
| March 15 | do | 2,250 | 2.18 | 3.2 | 4,909 |
| March 17 | do | 3,054 | 3.81 | 4.95 | 11,642 |
| March 24 | do | 3,550 | 3.72 | 3.9 | 9,480 |
| March 28 | do | 2,190 | 2.23 | 3.0 | 4,889 |
| May 1 [a] | do | 2,288 | 2.33 | 3.2 | 5,329 |
| May 7 | do | 2,343 | 2.16 | 3.3 | 5,066 |
| May 13 | do | 2,472 | 2.25 | 3.5 | 5,551 |
| May 19 | do | 2,330 | 2.24 | 3.6 | 5,208 |
| May 21 | do | 2,461 | 1.79 | 3.0 | 4,416 |
| May 24 | do | 2,420 | 2.28 | 3.3 | 5,516 |
| May 25 [b] | do | 2,521 | 2.40 | 4.2 | 6,049 |
| May 27 | do | 3,800 | 4.54 | 7.55 | 17,256 |
| June 10 | do | 2,806 | 4.86 | 5.8 | 13,646 |
| June 12 | do | 2,785 | 3.85 | 5.0 | 10,710 |
| June 14 | do | 2,677 | 5.18 | 6.0 | 13,867 |

[a] The record of measurements made during April was lost in a cyclone which occurred April 28.
[b] Gage height uncertain.

*Discharge measurements of Rio Grande near Laredo, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 18 | Luis Varela | 2,852 | 5.18 | 7.0 | 14,760 |
| June 23 | .....do | 3,229 | 5.39 | 7.75 | 17,407 |
| June 25 | .....do | 2,701 | 5.19 | 6.6 | 14,005 |
| July 2 | .....do | 5,370 | 5.73 | 12.2 | 30,749 |
| July 3 | .....do | 4,944 | 5.67 | 11.9 | 28,044 |
| July 13 | .....do | 2,622 | 3.19 | 6.3 | 8,369 |
| July 16 | .....do | 2,554 | 2.59 | 5.8 | 6,603 |
| July 23 | .....do | 2,358 | 2.56 | 5.5 | 6,025 |
| July 26 | .....do | 2,322 | 2.48 | 5.4 | 5,751 |
| July 27 | .....do | 2,664 | 3.70 | 7.2 | 9,854 |
| August 8 | .....do | 2,538 | 2.53 | 5.0 | 6,426 |
| August 11 | .....do | 3,787 | 5.70 | 8.2 | 21,602 |
| August 15 | .....do | 3,809 | 3.23 | 6.45 | 12,318 |
| August 16 | .....do | 3,648 | 3.86 | 6.6 | 14,091 |
| August 21 | .....do | 3,647 | 3.29 | 5.4 | 11,993 |
| August 27 | .....do | 3,179 | 3.74 | 6.2 | 11,893 |
| August 29 | .....do | 3,490 | 3.66 | 6.5 | 12,777 |
| September 2 | .....do | 3,017 | 2.94 | 5.1 | 8,867 |
| September 7 | .....do | 3,212 | 2.69 | 4.2 | 8,627 |
| September 13 | .....do | 4,723 | 4.96 | 8.35 | 23,416 |
| September 16 | .....do | 4,314 | 3.76 | 7.0 | 16,227 |
| September 22 | .....do | 3,102 | 3.31 | 5.8 | 10,256 |
| September 27 | .....do | 3,315 | 3.61 | 6.55 | 11,981 |
| September 29 | .....do | 4,634 | 5.02 | 9.9 | 23,270 |
| October 4 | .....do | 3,321 | 4.82 | 7.0 | 15,998 |
| October 10 | .....do | 3,410 | 5.14 | 7.25 | 17,534 |
| October 17 | .....do | 2,514 | 2.97 | 4.85 | 7,456 |
| October 18 | .....do | 2,456 | 2.89 | 4.8 | 7,101 |
| October 26 | .....do | 2,302 | 2.42 | 4.3 | 5,574 |
| October 30 | .....do | 2,247 | 2.06 | 3.9 | 4,627 |
| November 3 | .....do | 2,104 | 2.11 | 3.8 | 4,438 |
| November 12 | .....do | 2,028 | 1.81 | 3.1 | 3,671 |
| November 15 | .....do | 2,135 | 2.23 | 3.9 | 4,760 |
| November 17 | .....do | 3,012 | 4.60 | 6.65 | 13,855 |
| November 24 | .....do | 2,620 | 3.75 | 5.5 | 9,823 |
| November 30 | .....do | 2,247 | 2.32 | 4.4 | 5,221 |
| December 3 | .....do | 2,145 | 2.42 | 4,3 | 5,201 |
| December 8 | .....do | 2,709 | 2.51 | 5.3 | 6,807 |
| December 14 | .....do | 2,439 | 2.80 | 4.7 | 6,823 |
| December 16 | .....do | 2,239 | 2.48 | 4.5 | 5,549 |
| December 22 | .....do | 2,941 | 3.34 | 5.8 | 9,812 |
| December 26 | .....do | 2,816 | 4.19 | 6.2 | 11,793 |

*Daily gage height, in feet, of Rio Grande near Laredo, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 1.6 | 1.5 | 2.9 | 3.55 | 4.5 | 18.6 | 7.25 | 5.6 | 7.2 | 3.9 | 4.45 |
| 2 | 2.3 | 1.6 | 1.6 | 4.25 | 3.6 | 4.15 | 11.2 | 7.05 | 5.15 | 6.65 | 3.95 | 4.45 |
| 3 | 2.25 | 1.6 | 1.7 | 6.65 | 3.75 | 4.2 | 10.5 | 7.05 | 4.8 | 6.5 | 3.7 | 4.25 |
| 4 | 2.2 | 1.6 | 1.75 | 3.2 | 3.55 | 4.2 | 9.8 | 7.15 | 4.4 | 7.4 | 4.2 | 4.25 |
| 5 | 2.15 | 1.65 | 1.9 | 3.2 | 3.5 | 4.45 | 9.3 | 6.85 | 4.65 | 8.2 | 4.05 | 5.3 |
| 6 | 2.0 | 1.7 | 2.2 | 3.0 | 3.35 | 4.5 | 8.1 | 6.45 | 4.8 | 6.8 | 3.9 | 5.3 |
| 7 | 2.0 | 1.7 | 2.3 | 2.9 | 3.3 | 4.45 | 7.75 | 5.65 | 4.55 | 6.35 | 3.85 | 5.35 |
| 8 | 2.05 | 1.7 | 2.45 | 2.9 | 3.65 | 3.75 | 7.5 | 5.1 | 4.6 | 6.15 | 3.6 | 5.35 |
| 9 | 2.2 | 1.7 | 2.5 | 2.8 | 3.55 | 4.25 | 7.25 | 7.05 | 4.7 | 6.55 | 3.35 | 5.3 |
| 10 | 2.2 | 1.6 | 2.8 | 2.6 | 3.7 | 5.2 | 7.05 | 7.0 | 4.55 | 7.15 | 3.55 | 5.3 |
| 11 | 2.15 | 1.5 | 4.1 | 3.15 | 3.85 | 5.0 | 6.8 | 8.25 | 5.1 | 6.9 | 3.5 | 5.35 |
| 12 | 2.0 | 1.5 | 3.3 | 2.9 | 3.85 | 5.0 | 6.3 | 7.5 | 6.9 | 5.95 | 3.05 | 4.45 |
| 13 | 1.9 | 1.5 | 3.3 | 2.8 | 3.55 | 5.05 | 6.25 | 6.85 | 7.9 | 5.55 | 3.25 | 4.9 |
| 14 | 1.9 | 1.5 | 3.25 | 2.6 | 4.1 | 6.0 | 6.05 | 6.7 | 7.25 | 5.35 | 4.0 | 4.75 |
| 15 | 1.9 | 1.5 | 3.2 | 2.6 | 5.1 | 6.1 | 5.95 | 7.15 | 7.25 | 5.2 | 3.95 | 4.7 |
| 16 | 1.85 | 1.5 | 4.45 | 2.5 | 4.1 | 6.7 | 5.75 | 6.8 | 7.0 | 5.0 | 5.15 | 4.65 |
| 17 | 1.8 | 1.5 | 4.65 | 2.45 | 3.65 | 7.3 | 5.6 | 6.8 | 6.65 | 4.9 | 6.8 | 4.6 |
| 18 | 1.8 | 1.5 | 3.65 | 2.4 | 3.7 | 7.0 | 5.55 | 7.2 | 6.2 | 4.75 | 6.2 | 4.55 |
| 19 | 1.8 | 1.5 | 3.0 | 2.3 | 3.45 | 7.45 | 5.6 | 7.15 | 6.1 | 4.55 | 6.35 | 4.4 |
| 20 | 1.7 | 1.5 | 3.5 | 2.25 | 3.05 | 7.45 | 5.4 | 6.25 | 6.65 | 4.55 | 5.9 | 4.4 |
| 21 | 1.7 | 1.5 | 3.7 | 2.25 | 3.15 | 6.95 | 5.0 | 5.6 | 6.35 | 4.6 | 6.0 | 4.4 |
| 22 | 1.7 | 1.5 | 3.7 | 2.45 | 5.0 | 7.7 | 5.3 | 6.1 | 5.6 | 4.4 | 5.85 | 5.8 |
| 23 | 1.6 | 1.5 | 3.85 | 2.95 | 3.75 | 7.25 | 5.55 | 5.55 | 5.1 | 4.4 | 5.45 | 5.85 |
| 24 | 1.6 | 1.5 | 3.85 | 2.9 | 3.85 | 7.4 | 5.85 | 5.25 | 5.0 | 4.5 | 5.45 | 6.15 |
| 25 | 1.6 | 1.5 | 3.5 | 4.25 | 4.5 | 6.55 | 5.95 | 5.2 | 4.75 | 4.45 | 5.1 | 6.0 |
| 26 | 1.6 | 1.5 | 3.5 | 4.1 | 5.6 | 6.55 | 6.1 | 5.1 | 4.85 | 4.25 | 4.9 | 6.3 |
| 27 | 1.6 | 1.5 | 3.35 | 3.55 | 7.1 | 6.7 | 7.2 | 6.1 | 6.6 | 4.1 | 4.7 | 5.7 |
| 28 | 1.6 | 1.5 | 3.1 | 3.2 | 6.1 | 6.55 | 7.4 | 6.15 | 9.2 | 3.9 | 4.65 | 5.0 |
| 29 | 1.6 | ....... | 3.0 | 3.05 | 5.65 | 6.35 | 7.55 | 6.45 | 9.55 | 3.95 | 4.55 | 4.8 |
| 30 | 1.6 | ....... | 3.0 | 3.35 | 4.3 | 23.0 | 7.55 | 5.45 | 8.75 | 3.85 | 4.45 | 4.6 |
| 31 | 1.6 | ....... | 2.95 | ....... | 4.0 | ....... | 7.8 | 5.3 | ....... | 3.95 | ....... | 4.35 |

## RIO GRANDE NEAR ROMA, TEX.

This station was established in 1900 by the International (Water) Boundary Commission. It is near Roma, Tex., 775 miles by river below El Paso.

The river is straight for 1 mile above and one-half mile below the station. The right bank is alluvial deposit and overflows in high water for a width of 250 feet. The overflow section is thickly covered with mesquite brush. The left bank is of hard material and does not overflow. The bottom is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling spiked to posts and trees. Low water is 1 foot on gage, and the highest recorded flood, September 16, 1904, marked 26.0 feet on gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

*Discharge measurements of Rio Grande near Roma, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | H. P. Guerra | 3,026 | 2.13 | 3.8 | 6,452 |
| January 6 | do | 2,811 | 2.01 | 3.5 | 5,644 |
| January 14 | do | 2,042 | 2.05 | 3.1 | 4,193 |
| January 17 | do | 1,815 | 2.06 | 2.9 | 3,740 |
| January 20 | do | 1,854 | 2.14 | 3.0 | 3,959 |
| January 24 | do | 1,704 | 2.07 | 2.8 | 3,532 |
| January 27 | do | 1,693 | 1.93 | 2.7 | 3,262 |
| February 8 | do | 1,644 | 1.88 | 2.5 | 3,089 |
| February 11 | do | 1,684 | 1.90 | 2.6 | 3,205 |
| February 14 | do | 1,653 | 2.12 | 2.6 | 3,512 |
| February 17 | do | 1,690 | 1.83 | 2.5 | 3,100 |
| February 20 | do | 1,758 | 2.07 | 2.7 | 3,642 |
| February 23 | do | 1,590 | 2.05 | 2.5 | 3,257 |
| March 3 | do | 1,912 | 2.23 | 3.2 | 4,263 |
| March 6 | do | 2,332 | 2.44 | 4.0 | 5,689 |
| March 7 | do | 3,683 | 4.24 | 7.05 | 15,600 |
| March 13 | do | 2,277 | 3.39 | 4.5 | 7,716 |
| March 17 | do | 2,748 | 4.49 | 5.4 | 12,331 |
| March 23 | do | 2,324 | 3.47 | 4.6 | 8,066 |
| April 4 | do | 3,251 | 4.40 | 6.7 | 14,303 |
| April 7 | do | 2,040 | 3.34 | 4.1 | 6,811 |
| April 11 | do | 1,929 | 2.73 | 3.8 | 5,260 |
| April 18 | do | 2,009 | 2.87 | 3.9 | 5,760 |
| April 24 | do | 2,242 | 3.07 | 4.4 | 6,876 |
| April 26 | do | 2,801 | 4.43 | 5.6 | 12,422 |
| April 27 | do | 2,487 | 3.62 | 4.8 | 8,991 |
| May 2 | do | 2,467 | 3.05 | 4.6 | 7,528 |
| May 9 | do | 2,575 | 3.05 | 5.0 | 7,858 |
| May 12 | do | 3,097 | 4.11 | 6.1 | 12,740 |
| May 16 | do | 2,786 | 3.87 | 5.6 | 10,770 |
| May 23 | do | 2,736 | 3.88 | 5.55 | 10,628 |
| May 26 | do | 3,606 | 4.80 | 7.4 | 17,312 |
| May 31 | do | 3,385 | 4.56 | 6.9 | 15,450 |
| June 2 | do | 3,584 | 4.64 | 7.3 | 16,624 |
| June 6 | do | 2,836 | 3.72 | 5.6 | 10,546 |
| June 13 | do | 3,290 | 3.74 | 6.2 | 12,308 |
| June 16 | do | 3,645 | 4.25 | 6.9 | 15,481 |
| June 19 | do | 4,033 | 4.66 | 7.8 | 18,803 |
| June 22 | do | 4,252 | 4.93 | 8.3 | 20,966 |
| June 27 | do | 4,557 | 5.26 | 9.0 | 23,973 |
| July 3 | do | 8,374 | 5.14 | 17.0 | 43,041 |
| July 5 | do | 5,682 | 5.22 | 11.5 | 29,642 |
| July 7 | do | 4,368 | 5.17 | 8.7 | 22,568 |
| July 10 | do | 3,923 | 3.67 | 7.3 | 14,387 |
| July 14 | do | 4,004 | 2.82 | 6.1 | 11,289 |
| July 17 | do | 3,850 | 2.74 | 5.7 | 10,531 |
| July 20 | do | 3,685 | 2.61 | 5.3 | 9,633 |
| August 8 | do | 3,155 | 3.94 | 6.2 | 12,437 |
| August 11 | do | 3,299 | 4.13 | 6.6 | 13,641 |
| August 15 | do | 4,058 | 4.38 | 7.7 | 17,767 |
| August 17 | do | 3,796 | 3.76 | 7.2 | 14,267 |
| August 22 | do | 3,433 | 4.05 | 6.9 | 13,912 |
| August 24 | do | 4,143 | 4.61 | 7.9 | 19,116 |

*Discharge measurements of Rio Grande near Roma, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 5 | H. F. Guerra | 2,902 | 3.11 | 5.2 | 9,016 |
| September 8 | do | 2,751 | 3.01 | 4.9 | 8,277 |
| September 13 | do | 4,083 | 4.60 | 7.8 | 18,789 |
| September 19 | do | 6,224 | 5.38 | 12.7 | 33,475 |
| September 21 | do | 4,933 | 4.82 | 9.7 | 23,783 |
| September 23 | do | 3,763 | 4.42 | 7.1 | 16,643 |
| September 29 | do | 4,246 | 4.59 | 8.1 | 19,481 |
| October 5 | do | 4,482 | 4.74 | 8.5 | 21,263 |
| October 7 | do | 3,816 | 4.42 | 7.2 | 16,878 |
| October 9 | do | 3,425 | 4.11 | 6.8 | 14,079 |
| October 13 | do | 3,294 | 3.63 | 6.1 | 11,944 |
| October 17 | do | 2,981 | 3.37 | 5.5 | 10,047 |
| October 20 | do | 2,836 | 2.60 | 5.1 | 7,382 |
| October 24 | do | 2,530 | 2.64 | 4.5 | 6,688 |
| November 7 | do | 2,334 | 2.52 | 4.4 | 5,893 |
| November 10 | do | 2,138 | 2.05 | 4.0 | 4,390 |
| November 17 | do | 3,031 | 4.07 | 6.0 | 12,322 |
| November 20 | do | 3,294 | 4.01 | 6.6 | 13,200 |
| November 25 | do | 2,814 | 3.51 | 5.5 | 9,866 |
| November 28 | do | 2,618 | 3.29 | 5.0 | 8,622 |
| December 9 | do | 2,706 | 3.47 | 5.3 | 9,394 |
| December 11 | do | 2,557 | 3.08 | 4.9 | 7,872 |
| December 14 | do | 2,358 | 3.19 | 4.7 | 7,531 |
| December 20 | do | 2,244 | 3.13 | 4.4 | 7,027 |
| December 23 | do | 2,938 | 3.53 | 5.8 | 10,370 |
| December 28 | do | 2,891 | 3.29 | 5.5 | 9,514 |

*Daily gage height, in feet, of Rio Grande near Roma, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.8 | 3.0 | 2.7 | 4.1 | 5.3 | 6.35 | 17.7 | 7.65 | 5.8 | 8.2 | 4.75 | 4.75 |
| 2 | 3.8 | 3.0 | 3.05 | 4.35 | 4.6 | 7.0 | 22.3 | 7.75 | 5.55 | 6.9 | 4.65 | 4.7 |
| 3 | 3.8 | 2.85 | 3.15 | 4.8 | 4.7 | 6.35 | 16.55 | 7.35 | 5.35 | 6.6 | 4.55 | 4.65 |
| 4 | 3.7 | 2.8 | 2.9 | 6.75 | 4.75 | 6.3 | 13.75 | 7.1 | 5.05 | 7.15 | 4.45 | 4.6 |
| 5 | 3.65 | 2.7 | 3.2 | 4.75 | 4.7 | 5.85 | 10.9 | 6.9 | 5.2 | 8.5 | 4.6 | 4.55 |
| 6 | 3.55 | 2.7 | 3.85 | 4.2 | 4.7 | 5.6 | 9.15 | 6.75 | 5.4 | 7.85 | 4.55 | 4.7 |
| 7 | 3.45 | 2.6 | 6.35 | 4.05 | 4.75 | 5.65 | 8.55 | 6.65 | 5.0 | 7.05 | 4.45 | 4.95 |
| 8 | 3.4 | 2.55 | 4.7 | 3.9 | 4.8 | 5.55 | 7.9 | 6.35 | 4.9 | 6.5 | 4.15 | 5.45 |
| 9 | 3.4 | 2.5 | 3.65 | 4.0 | 5.1 | 5.6 | 7.35 | 6.1 | 4.8 | 6.55 | 4.3 | 5.35 |
| 10 | 3.3 | 2.6 | 3.45 | 3.9 | 5.0 | 5.7 | 7.15 | 6.4 | 4.8 | 7.1 | 4.05 | 5.25 |
| 11 | 3.3 | 2.6 | 3.75 | 3.85 | 5.05 | 6.15 | 6.95 | 6.5 | 5.1 | 7.2 | 4.0 | 5.05 |
| 12 | 3.25 | 2.6 | 4.5 | 3.9 | 6.0 | 6.2 | 6.7 | 6.6 | 5.45 | 6.6 | 4.0 | 4.9 |
| 13 | 3.2 | 2.6 | 4.4 | 3.9 | 5.15 | 6.15 | 6.45 | 6.5 | 7.35 | 6.2 | 4.05 | 4.8 |
| 14 | 3.15 | 2.6 | 3.95 | 4.1 | 4.8 | 6.4 | 6.2 | 6.35 | 7.45 | 5.85 | 4.0 | 4.75 |
| 15 | 3.05 | 2.5 | 3.9 | 4.25 | 5.5 | 6.75 | 5.95 | 7.7 | 6.4 | 5.65 | 4.3 | 4.65 |
| 16 | 3.0 | 2.5 | 3.9 | 4.0 | 5.7 | 6.95 | 5.75 | 7.35 | 6.5 | 5.55 | 4.25 | 4.6 |
| 17 | 2.9 | 2.5 | 4.85 | 3.9 | 5.05 | 7.4 | 5.8 | 7.05 | 6.55 | 5.5 | 5.55 | 4.5 |
| 18 | 2.9 | 2.55 | 5.25 | 3.95 | 4.75 | 7.55 | 6.4 | 6.7 | 6.1 | 5.3 | 6.15 | 4.5 |
| 19 | 2.95 | 2.95 | 4.45 | 4.0 | 4.55 | 7.75 | 5.65 | 7.2 | 11.3 | 5.3 | 5.6 | 4.5 |
| 20 | 3.0 | 2.75 | 4.35 | 3.95 | 4.45 | 7.7 | 5.45 | 6.9 | 10.1 | 5.55 | 6.45 | 4.45 |
| 21 | 2.9 | 2.6 | 4.4 | 3.9 | 4.5 | 7.75 | 5.6 | 6.9 | 9.3 | 5.6 | 5.9 | 4.4 |
| 22 | 2.9 | 2.6 | 4.55 | 3.9 | 4.5 | 8.15 | 6.9 | 6.95 | 8.7 | 5.8 | 5.9 | 5.1 |
| 23 | 2.8 | 2.6 | 4.6 | 3.95 | 5.15 | 8.15 | 7.2 | 7.55 | 7.5 | 5.1 | 5.8 | 5.7 |
| 24 | 2.8 | 2.45 | 4.5 | 4.5 | 4.65 | 7.95 | 6.95 | 7.7 | 5.9 | 4.5 | 5.75 | 5.55 |
| 25 | 2.8 | 2.4 | 4.5 | 4.35 | 4.8 | 7.85 | 6.85 | 6.7 | 5.65 | 4.35 | 5.55 | 5.6 |
| 26 | 2.8 | 2.35 | 4.4 | 4.85 | 6.75 | 7.65 | 7.15 | 6.4 | 5.55 | 4.5 | 5.35 | 5.75 |
| 27 | 2.7 | 2.3 | 4.4 | 4.95 | 6.4 | 8.8 | 7.2 | 6.4 | 5.45 | 4.4 | 5.05 | 5.7 |
| 28 | 2.85 | 2.15 | 4.4 | 4.65 | 6.8 | 8.35 | 7.65 | 6.25 | 6.4 | 4.45 | 4.95 | 5.55 |
| 29 | 2.9 | ....... | 4.3 | 5.1 | 6.55 | 8.0 | 6.9 | 6.75 | 8.3 | 4.3 | 4.85 | 5.4 |
| 30 | 3.0 | ....... | 4.2 | 5.8 | 7.3 | 8.25 | 6.85 | 6.45 | 8.9 | 4.2 | 4.8 | 5.15 |
| 31 | 3.0 | ....... | 4.2 | ....... | 6.5 | ....... | 6.95 | 6.2 | ....... | 4.3 | ....... | 5.0 |

## RIO GRANDE NEAR BROWNSVILLE, TEX.

This station was established in 1900 by the International (Water) Boundary Commission. It is about 1 mile above Brownsville, Tex., and in front of Matamoros, Tamaulipas, and 960 miles by river below El Paso.

Between Roma and Brownsville there are many lagoons (old river beds) and lakes which take river water during moderate floods, and a large area overflows quite deeply in larger floods. Much of this water returns slowly to the river as the flood subsides, so that the flow passes Brownsville more uniformly than it does Roma. Large quantities of water also leave the river entirely, reaching the Gulf of Mexico through channels remote from the Rio Grande Local run-off, however, keeps the total water at Brownsville well up toward the combined flow of the San Juan and the Rio Grande at Roma. The river is nearly straight for one-half mile above and below the station. Both banks are alluvial and are just about level with high water. The right bank is protected by piling. The bed of the stream is shifting sand.

Discharge measurements are made by means of a cable, car, and guy wire. The cable is so constructed that it can be lowered and raised. The initial point for soundings is the cable support on the right bank.

The gage is a vertical scantling fastened to one of the protection piles. High water is 13 feet on the gage, and low water is —1.0.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

*Discharge measurements of Rio Grande near Brownsville, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 2 | P. Guerra | 2,886 | 2.60 | 5.3 | 7,492 |
| January 6 | do | 2,712 | 2.59 | 4.7 | 7,036 |
| January 10 | do | 2,588 | 2.41 | 4.3 | 6,230 |
| January 14 | do | 2,531 | 2.34 | 4.1 | 5,935 |
| January 18 | do | 2,381 | 2.33 | 3.8 | 5,545 |
| January 22 | do | 2,318 | 2.32 | 3.5 | 5,384 |
| January 26 | do | 2,301 | 2.30 | 3.4 | 5,295 |
| January 30 | do | 2,247 | 2.16 | 3.2 | 4,853 |
| February 3 | do | 2,252 | 2.24 | 3.4 | 5,053 |
| February 7 | do | 2,276 | 2.29 | 3.5 | 5,204 |
| February 11 | do | 2,138 | 2.20 | 3.0 | 4,711 |
| February 16 | do | 2,112 | 2.17 | 2.9 | 4,583 |
| February 24 | do | 2,230 | 2.22 | 3.1 | 4,961 |
| February 27 | do | 2,122 | 2.17 | 2.8 | 4,595 |
| March 3 | do | 2,172 | 2.21 | 2.9 | 4,796 |
| March 7 | do | 2,283 | 2.30 | 3.5 | 5,259 |
| March 13 | do | 2,321 | 3.30 | 5.2 | 7,653 |
| March 17 | do | 2,468 | 3.41 | 5.7 | 8,414 |
| March 20 | do | 3,141 | 3.36 | 7.6 | 10,548 |
| March 25 | do | 2,926 | 3.44 | 6.5 | 10,058 |
| March 29 | do | 2,964 | 3.43 | 6.5 | 10,163 |
| April 2 | do | 2,734 | 3.31 | 5.8 | 9,043 |
| April 6 | do | 4,010 | 4.55 | 9.25 | 18,251 |
| April 11 | do | 2,835 | 2.19 | 5.1 | 6,206 |
| April 16 | do | 2,735 | 2.19 | 4.9 | 6,001 |
| April 24 | do | 2,535 | 2.03 | 4.0 | 5,135 |
| April 28 | do | 3,528 | 3.22 | 6.8 | 11,362 |
| May 2 | do | 3,117 | 3.49 | 7.65 | 10,885 |
| May 6 | do | 2,635 | 3.33 | 6.3 | 8,771 |
| May 10 | do | 2,524 | 3.18 | 6.0 | 8,024 |
| May 14 | do | 3,086 | 3.44 | 7.5 | 10,623 |
| May 18 | do | 4,015 | 3.27 | 7.9 | 13,120 |
| May 22 | do | 2,566 | 3.35 | 6.1 | 8,596 |
| May 26 | do | 3,575 | 3.12 | 6.8 | 11,162 |
| May 30 | do | 4,980 | 4.67 | 10.5 | 23,258 |
| June 3 | do | 5,282 | 4.60 | 11.2 | 24,294 |
| June 6 | do | 5,136 | 4.03 | 10.8 | 20,716 |
| June 11 | do | 4,268 | 3.65 | 8.4 | 15,583 |
| June 15 | do | 4,508 | 3.72 | 9.0 | 16,772 |
| June 20 | do | 5,516 | 4.42 | 11.7 | 24,397 |
| June 24 | do | 5,967 | 4.78 | 12.7 | 28,515 |
| June 28 | do | 5,716 | 4.63 | 12.2 | 28,485 |
| July 2 | do | 6,103 | 4.60 | 13.1 | 28,091 |
| July 6 | do | 6,274 | 4.65 | 13.5 | 29,168 |
| July 10 | do | 6,105 | 4.11 | 13.3 | 25,099 |
| July 12 | do | 5,148 | 3.64 | 11.0 | 18,734 |
| July 18 | do | 4,290 | 2.79 | 8.8 | 11,949 |
| July 22 | do | 4,521 | 3.20 | 9.5 | 14,452 |
| July 26 | do | 4,071 | 3.50 | 9.3 | 14,231 |

*Discharge measurements of Rio Grande near Brownsville, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 30 | P. Guerra | 4,899 | 3.73 | 11.65 | 18,275 |
| August 3 | do | 4,806 | 4.42 | 11.3 | 21,236 |
| August 7 | do | 4,561 | 4.03 | 10.5 | 18,382 |
| August 11 | do | 4,038 | 3.64 | 9.4 | 14,697 |
| August 15 | do | 4,118 | 3.68 | 9.6 | 15,135 |
| August 19 | do | 4,621 | 3.99 | 10.6 | 18,435 |
| August 24 | do | 4,723 | 4.11 | 10.8 | 19,390 |
| August 28 | do | 4,008 | 3.59 | 9.25 | 14,399 |
| September 1 | do | 4,756 | 3.32 | 9.6 | 15,773 |
| September 6 | do | 4,169 | 2.39 | 7.5 | 9,946 |
| September 10 | do | 4,039 | 2.21 | 7.1 | 8,937 |
| September 14 | do | 4,091 | 2.27 | 7.3 | 9,301 |
| September 18 | do | 4,899 | 3.32 | 9.8 | 16,287 |
| September 21 | do | 6,069 | 4.77 | 12.8 | 28,944 |
| September 25 | do | 6,202 | 5.00 | 13.1 | 31,029 |
| September 29 | do | 3,448 | 2.97 | 8.1 | 10,259 |
| October 3 | do | 5,260 | 4.39 | 12.8 | 23,081 |
| October 7 | do | 5,407 | 4.95 | 13.1 | 26,749 |
| October 11 | do | 4,714 | 3.55 | 11.3 | 16,714 |
| October 15 | do | 5,127 | 3.14 | 10.7 | 16,121 |
| October 20 | do | 4,416 | 2.30 | 8.1 | 10,171 |
| October 24 | do | 4,582 | 2.50 | 8.5 | 11,476 |
| October 29 | do | 3,627 | 1.88 | 6.5 | 6,802 |
| November 2 | do | 3,622 | 2.03 | 6.1 | 7,338 |
| November 6 | do | 3,407 | 3.22 | 7.9 | 10,956 |
| November 8 | do | 3,462 | 3.38 | 8.1 | 11,697 |
| November 14 | do | 3,827 | 2.15 | 6.7 | 8,237 |
| November 18 | do | 3,630 | 2.16 | 6.5 | 7,833 |
| November 22 | do | 4,972 | 4.02 | 10.1 | 20,002 |
| November 26 | do | 3,607 | 3.74 | 8.7 | 13,500 |
| November 29 | do | 3,272 | 3.37 | 7.9 | 11,011 |
| December 3 | do | 3,724 | 2.41 | 6.6 | 8,970 |
| December 8 | do | 3,453 | 2.21 | 6.3 | 7,638 |
| December 12 | do | 3,216 | 3.27 | 7.8 | 10,506 |
| December 17 | do | 3,813 | 2.46 | 6.9 | 9,394 |
| December 21 | do | 3,596 | 2.16 | 6.3 | 7,767 |
| December 25 | do | 3,460 | 3.32 | 8.0 | 11,487 |
| December 29 | do | 4,025 | 3.56 | 8.6 | 14,349 |

*Daily gage height, in feet, of Rio Grande near Brownsville, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.45 | 3.2 | 2.7 | 6.1 | 7.4 | 11.05 | 12.7 | 10.7 | 9.5 | 12.75 | 6.2 | 7.05 |
| 2 | 5.35 | 3.4 | 2.7 | 5.75 | 7.5 | 10.35 | 13.0 | 10.9 | 8.9 | 13.1 | 6.1 | 6.85 |
| 3 | 5.15 | 3.4 | 2.9 | 5.55 | 6.3 | 11.8 | 13.1 | 11.3 | 8.4 | 12.95 | 6.65 | 6.65 |
| 4 | 4.95 | 3.4 | 3.15 | 5.65 | 6.05 | 12.5 | 13.15 | 11.55 | 8.0 | 11.45 | 11.55 | 6.55 |
| 5 | 4.85 | 3.45 | 3.35 | 9.0 | 6.15 | 11.7 | 13.4 | 11.1 | 7.7 | 10.85 | 10.1 | 6.45 |
| 6 | 4.65 | 3.6 | 3.4 | 9.25 | 6.3 | 11.05 | 13.5 | 10.65 | 7.45 | 12.65 | 8.05 | 6.3 |
| 7 | 4.6 | 3.45 | 3.45 | 6.75 | 6.3 | 9.7 | 13.5 | 10.45 | 7.2 | 13.1 | 7.4 | 6.3 |
| 8 | 4.5 | 3.25 | 5.85 | 5.6 | 6.2 | 8.8 | 13.5 | 10.25 | 7.35 | 13.05 | 8.1 | 6.3 |
| 9 | 4.35 | 3.1 | 7.7 | 5.3 | 6.05 | 8.55 | 13.5 | 9.9 | 7.35 | 13.0 | 8.35 | 6.9 |
| 10 | 4.25 | 3.05 | 7.7 | 5.2 | 6.1 | 8.45 | 12.95 | 9.6 | 7.15 | 12.25 | 7.9 | 7.7 |
| 11 | 4.25 | 2.95 | 6.0 | 5.15 | 6.45 | 8.4 | 11.65 | 9.4 | 6.95 | 11.25 | 7.45 | 8.0 |
| 12 | 4.15 | 2.9 | 5.05 | 5.1 | 6.6 | 8.55 | 10.9 | 9.55 | 6.75 | 11.65 | 7.25 | 7.7 |
| 13 | 4.25 | 2.9 | 5,1 | 5.0 | 6.5 | 8.9 | 10.6 | 9.65 | 6.75 | 11.55 | 6.95 | 7.35 |
| 14 | 4.1 | 2.9 | 6.1 | 5.0 | 7.35 | 9.0 | 10.3 | 9.75 | 7.5 | 11.1 | 6.75 | 7.2 |
| 15 | 4.0 | 2.9 | 6.1 | 4.95 | 7.5 | 9.05 | 9.7 | 9.5 | 11.0 | 10.5 | 6.55 | 7.1 |
| 16 | 3.95 | 2.9 | 5.85 | 4.9 | 6.85 | 9.35 | 9.15 | 9.15 | 10.95 | 9.7 | 6.4 | 7.05 |
| 17 | 3.9 | 2.9 | 5.7 | 4.8 | 7.7 | 10.15 | 8.95 | 9.9 | 9.8 | 9.0 | 6.4 | 6.9 |
| 18 | 3.8 | 2.9 | 5.7 | 4.75 | 7.75 | 10.7 | 8.75 | 10.95 | 9.75 | 8.65 | 6.5 | 6.8 |
| 19 | 3.8 | 2.9 | 6.95 | 4.65 | 6.6 | 11.35 | 10.45 | 10.5 | 9.55 | 8.4 | 8.95 | 6.65 |
| 20 | 3.7 | 2.9 | 7.55 | 4.45 | 6.1 | 11.75 | 12.4 | 10.4 | 9.75 | 8.15 | 9.7 | 6.45 |
| 21 | 3.6 | 2.9 | 6.6 | 4.4 | 6.1 | 12.0 | 10.8 | 10.75 | 12.85 | 8.15 | 9.3 | 6.3 |
| 22 | 3.5 | 3.0 | 6.15 | 4.25 | 6.1 | 12.05 | 9.05 | 10.5 | 13.05 | 8.95 | 10.15 | 6.15 |
| 23 | 3.5 | 3.1 | 6.1 | 4.1 | 6.1 | 12.5 | 8.3 | 10.3 | 13.25 | 8.5 | 10.15 | 6.55 |
| 24 | 3.5 | 3.1 | 6.35 | 4.05 | 6.1 | 12.7 | 9.2 | 10.7 | 13.4 | 8.5 | 9.4 | 7.8 |
| 25 | 3.5 | 2.9 | 6.5 | 3.85 | 6.75 | 12.65 | 9.6 | 11.5 | 12.25 | 8.35 | 9.1 | 8.0 |
| 26 | 3.4 | 2.9 | 6.65 | 3.8 | 6.8 | 12.3 | 9.3 | 11.65 | 9.75 | 7.6 | 8.8 | 7.9 |
| 27 | 3.3 | 2.8 | 6.7 | 4.6 | 6.95 | 12.05 | 9.8 | 9.65 | 8.75 | 6.9 | 8.45 | 7.8 |
| 28 | 3.2 | 2.8 | 6.65 | 6.55 | 9.4 | 12.3 | 10.4 | 9.15 | 8.35 | 6.65 | 8.05 | 8.5 |
| 29 | 3.2 | ....... | 6.5 | 6.55 | 9.75 | 12.75 | 11.7 | 8.6 | 8.1 | 6.45 | 7.75 | 8.55 |
| 30 | 3.2 | ....... | 6.35 | 6.1 | 10.4 | 12.8 | 11.4 | 9.2 | 8.0 | 6.35 | 7.3 | 8.2 |
| 31 | 3.2 | ....... | 6.15 | ....... | 10.6 | ....... | 10.9 | 9.7 | ....... | 6.25 | ....... | 7.6 |

## RIO SALADO NEAR GUERRERO, TAMAULIPAS, MEXICO.

This station was established in 1900 by the International (Water) Boundary Commission. The Salado is a torrential stream entering the Rio Grande from the Mexican side about 60 miles below Laredo, or 730 miles by river below El Paso. The town of Guerrero is located on the Salado some 4 miles above its mouth, and the gaging station is 2 miles above the town.

The river is a series of pools and rapids. The best pool available was chosen for the station. The river curves to the left both above and below the cable. The banks are sandy clay, not subject to erosion. The bottom is mud. In low water the river is measured by wading among rocks below the station.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support on the left bank.

The gage is an inclined scantling fastened to posts sunk in the bank. Low water (no flow) is −1 on the gage. The highest recorded flood, on June 16, 1903, gave 17.7 on gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

*Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | D. de Lassaulx | 1,789 | 0.51 | 3.6 | 916 |
| January 7 | do | 1,766 | .49 | 3.5 | 871 |
| January 11 | do | 1,747 | .46 | 3.4 | 795 |
| January 15 | do | 1,726 | .42 | 3.3 | 727 |
| January 19 | do | 1,481 | .43 | 3.2 | 638 |
| January 23 | do | 1,687 | .36 | 3.1 | 609 |
| January 28 | do | 1,665 | .34 | 3.0 | 560 |
| February 1 | do | 1,650 | .29 | 2.9 | 485 |
| February 5 | do | 1,628 | .26 | 2.8 | 431 |
| February 9 | do | 1,610 | .25 | 2.7 | 404 |
| February 13 | do | 1,615 | .25 | 2.6 | 405 |
| February 17 | do | 1,586 | .25 | 2.5 | 397 |
| February 21 | do | 1,585 | .25 | 2.5 | 395 |
| February 25 | do | 1,565 | .24 | 2.4 | 369 |
| March 1 | do | 1,556 | .23 | 2.3 | 352 |
| March 5 | do | 1,631 | .26 | 2.7 | 419 |
| March 7 | do | 2,050 | 1.01 | 4.8 | 2,067 |
| March 11 | do | 1,890 | .76 | 4.0 | 1,441 |
| March 18 | do | 1,729 | .40 | 3.3 | 683 |
| March 24 | do | 1,685 | .32 | 3.0 | 539 |
| March 28 | do | 1,624 | .27 | 2.8 | 435 |
| April 1 | do | 1,601 | .27 | 2.7 | 428 |
| April 5 | do | 1,583 | .26 | 2.6 | 415 |
| April 10 | do | 1,560 | .26 | 2.4 | 401 |
| April 14 | do | 1,531 | .24 | 2.3 | 366 |
| April 18 | do | 1,510 | .23 | 2.2 | 350 |
| April 22 | do | 1,492 | .18 | 2.1 | 265 |
| April 26 | do | 1,489 | .17 | 2.0 | 249 |
| May 2 | do | 1,632 | .32 | 2.9 | 518 |
| May 6 | do | 1,471 | .18 | 2.1 | 268 |
| May 10 | do | 1,411 | .16 | 1.7 | 219 |
| May 12 | do | 1,707 | .38 | 3.3 | 656 |
| May 17 | do | 1,482 | .18 | 2.1 | 266 |
| May 21 | do | 1,452 | .16 | 1.9 | 239 |
| May 26 | do | 2,421 | 2.26 | 6.75 | 5,479 |
| May 30 | do | 2,520 | 2.46 | 7.2 | 6,194 |
| June 3 | do | 1,698 | .89 | 4.0 | 1,506 |
| June 7 | do | 1,580 | .49 | 3.4 | 773 |
| June 11 | do | 1,475 | .42 | 3.0 | 624 |
| June 15 | do | 1,446 | .29 | 2.7 | 423 |
| June 20 | do | 1,366 | .25 | 2.3 | 337 |
| June 24 | do | 1,416 | .31 | 2.8 | 436 |
| June 28 | do | 2,076 | 1.86 | 6.0 | 3,861 |
| July 3 | do | 2,384 | 3.03 | 8.2 | 7,218 |
| July 7 | do | 1,762 | 1.43 | 5.2 | 2,523 |
| July 12 | do | 1,774 | 1.29 | 4.9 | 2,282 |
| July 16 | do | 1,708 | 1.23 | 4.7 | 2,095 |
| July 20 | do | 1,695 | 1.34 | 5.0 | 2,275 |
| July 23 | do | 1,784 | 1.67 | 5.5 | 2,984 |
| July 27 | do | 1,716 | 1.41 | 5.1 | 2,423 |
| August 1 | do | 1,681 | 1.19 | 4.9 | 1,992 |
| August 5 | do | 1,599 | 1.07 | 4.6 | 1,718 |
| August 9 | do | 1,559 | .98 | 4.4 | 1,530 |

*Discharge measurements of Rio Salado near Guerrero, Tamaulipas, Mexico, in 1905*—Cont'd.

| Date. | Hydrographer, | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 13 | D. de Lassaulx | 1,535 | 0.90 | 4.3 | 1,382 |
| August 18 | do | 1,488 | .83 | 4.0 | 1,238 |
| August 23 | do | 1,469 | .74 | 3.8 | 1,082 |
| August 28 | do | 1,427 | .71 | 3.7 | 1,007 |
| September 2 | do | 1,405 | .66 | 3.6 | 933 |
| September 7 | do | 1,405 | .62 | 3.5 | 870 |
| September 15 | do | 1,371 | .57 | 3.4 | 783 |
| September 20 | do | 1,973 | 2.43 | 6.4 | 4,798 |
| September 22 | do | 2,618 | 3.82 | 9.3 | 10,003 |
| September 25 | do | 1,427 | .83 | 3.8 | 1,182 |
| September 29 | do | 1,368 | .65 | 3.5 | 883 |
| October 4 | do | 2,031 | 2.61 | 7.0 | 5,291 |
| October 8 | do | 1,389 | .77 | 3.8 | 1,069 |
| October 12 | do | 1,354 | .69 | 3.6 | 935 |
| October 16 | do | 1,296 | .61 | 3.3 | 791 |
| October 21 | do | 1,907 | 2.23 | 6.4 | 4,261 |
| October 26 | do | 1,260 | .52 | 3.1 | 660 |
| October 29 | do | 1,243 | .50 | 3.0 | 616 |
| November 2 | do | 1,460 | .93 | 4.0 | 1,361 |
| November 6 | do | 1,246 | .45 | 3.0 | 559 |
| November 10 | do | 1,225 | .42 | 2.9 | 509 |
| November 14 | do | 1,202 | .40 | 2.8 | 478 |
| November 18 | do | 1,207 | .39 | 2.8 | 476 |
| November 22 | do | 1,280 | .48 | 3.2 | 611 |
| November 27 | do | 1,208 | .38 | 2.8 | 464 |
| December 1 | do | 1,172 | .38 | 2.7 | 445 |
| December 6 | do | 1,223 | .41 | 2.9 | 505 |
| December 10 | do | 1,152 | .37 | 2.6 | 422 |
| December 15 | do | 1,152 | .37 | 2.6 | 422 |
| December 19 | do | 1,220 | .41 | 2.9 | 505 |
| December 23 | do | 1,193 | .36 | 2.7 | 435 |
| December 28 | do | 1,164 | .36 | 2.6 | 418 |

*Daily gage height, in feet, of Rio Salado near Guerrero, Tamaulipas, Mexico, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.6 | 2.9 | 2.3 | 2.7 | 2.7 | 4.8 | 3.95 | 4.85 | 3.55 | 3.5 | 4.05 | 2.7 |
| 2 | 3.6 | 2.9 | 2.3 | 2.7 | 2.85 | 4.7 | 6.9 | 4.8 | 3.55 | 3.4 | 4.0 | 2.7 |
| 3 | 3.6 | 2.9 | 2.3 | 2.6 | 2.45 | 5.2 | 8.35 | 4.75 | 3.5 | 3.4 | 3.6 | 2.7 |
| 4 | 3.5 | 2.8 | 2.45 | 2.6 | 2.25 | 5.4 | 9.4 | 4.7 | 3.5 | 7.1 | 3.2 | 2.7 |
| 5 | 3.5 | 2.8 | 2.7 | 2.6 | 2.15 | 4.1 | 5.9 | 4.6 | 3.55 | 5.9 | 3.0 | 2.6 |
| 6 | 3.5 | 2.8 | 4.55 | 2.6 | 2.05 | 3.7 | 5.45 | 4.6 | 3.6 | 4.65 | 3.0 | 2.85 |
| 7 | 3.5 | 2.7 | 4.75 | 2.5 | 2.0 | 4.0 | 5.2 | 4.5 | 3.5 | 4.0 | 3.0 | 2.75 |
| 8 | 3.5 | 2.7 | 4.1 | 2.5 | 2.1 | 4.0 | 5.15 | 4.5 | 3.5 | 3.8 | 2.9 | 2.7 |
| 9 | 3.5 | 2.7 | 3.2 | 2.5 | 1.8 | 3.4 | 5.15 | 4.5 | 3.5 | 3.75 | 2.9 | 2.65 |
| 10 | 3.5 | 2.7 | 3.8 | 2.4 | 2.5 | 3.25 | 5.05 | 4.4 | 3.4 | 3.65 | 2.9 | 2.6 |
| 11 | 3.4 | 2.7 | 3.85 | 2.4 | 3.4 | 3.0 | 5.0 | 4.45 | 3.4 | 3.5 | 2.8 | 2.6 |
| 12 | 3.4 | 2.7 | 3.25 | 2.4 | 3.15 | 3.0 | 4.9 | 4.3 | 3.4 | 3.8 | 2.85 | 2.65 |
| 13 | 3.4 | 2.6 | 3.0 | 2.4 | 2.8 | 2.9 | 4.9 | 4.3 | 3.4 | 3.55 | 2.85 | 2.7 |
| 14 | 3.3 | 2.6 | 3.0 | 2.3 | 3.0 | 2.8 | 4.8 | 4.2 | 3.4 | 3.4 | 2.8 | 2.7 |
| 15 | 3.3 | 2.6 | 2.9 | 2.3 | 2.55 | 2.7 | 4.8 | 4.15 | 3.4 | 3.3 | 2.8 | 2.6 |
| 16 | 3.3 | 2.5 | 2.9 | 2.3 | 2.4 | 2.6 | 4.7 | 4.1 | 3.4 | 3.3 | 2.8 | 2.6 |
| 17 | 3.3 | 2.5 | 3.15 | 2.2 | 2.1 | 2.5 | 5.9 | 4.1 | 3.3 | 3.3 | 2.8 | 2.6 |
| 18 | 3.3 | 2.5 | 3.3 | 2.2 | 2.2 | 2.4 | 4.85 | 4.0 | 3.3 | 3.2 | 2.8 | 2.65 |
| 19 | 3.2 | 2.75 | 3.25 | 2.2 | 2.2 | 2.35 | 5.4 | 4.0 | 4.7 | 3.2 | 4.3 | 2.85 |
| 20 | 3.2 | 2.55 | 3.15 | 2.2 | 1.9 | 2.3 | 4.9 | 3.95 | 6.7 | 3.6 | 4.6 | 2.85 |
| 21 | 3.2 | 2.5 | 3.5 | 2.1 | 1.85 | 3.05 | 5.7 | 3.9 | 7.75 | 6.2 | 3.15 | 2.85 |
| 22 | 3.2 | 2.5 | 3.85 | 2.1 | 1.8 | 3.2 | 5.75 | 3.9 | 9.3 | 6.2 | 3.3 | 2.95 |
| 23 | 3.2 | 2.5 | 3.3 | 2.1 | 1.7 | 2.95 | 5.45 | 3.8 | 4.95 | 4.05 | 3.05 | 2.85 |
| 24 | 3.1 | 2.5 | 3.05 | 2.1 | 1.7 | 2.7 | 5.35 | 3.8 | 4.25 | 3.45 | 2.95 | 2.7 |
| 25 | 3.1 | 2.4 | 3.0 | 2.1 | 3.9 | 2.5 | 5.25 | 3.8 | 3.85 | 3.3 | 2.9 | 2.7 |
| 26 | 3.1 | 2.4 | 3.0 | 2.0 | 7.1 | 2.35 | 5.2 | 3.7 | 3.75 | 3.1 | 2.85 | 2.6 |
| 27 | 3.0 | 2.4 | 2.9 | 2.0 | 4.3 | 3.6 | 5.1 | 3.7 | 3.65 | 3.1 | 2.8 | 2.6 |
| 28 | 3.0 | 2.4 | 2.8 | 2.2 | 4.7 | 5.9 | 5.05 | 3.7 | 3.55 | 3.0 | 2.8 | 2.6 |
| 29 | 3.0 | ....... | 2.8 | 2.3 | 5.7 | 4.8 | 5.0 | 3.65 | 3.5 | 3.0 | 2.8 | 2.6 |
| 30 | 3.0 | ....... | 2.8 | 2.0 | 7.3 | 4.0 | 4.9 | 3.6 | 3.5 | 3.0 | 2.7 | 2.6 |
| 31 | 2.9 | ....... | 2.8 | ....... | 5.6 | ....... | 4.9 | 3.6 | ....... | 3.0 | ....... | 2.5 |

## RIO SAN JUAN NEAR SANTA ROSALIA RANCH, TAMAULIPAS, MEXICO.

This station was established in 1900 by the International (Water) Boundary Commission. The San Juan is a long torrential stream entering the Rio Grande 15 miles below Roma and 790 miles by river below El Paso. Six miles above its mouth is the town of Camargo. The station was first placed 12 miles above Camargo, but in time of heavy flood in the Rio Grande backwater reached the station, and on July 14, 1902, it was moved 6 miles farther upstream to its present location. It is now above backwater.

Both banks are sandy clay which are above high water and do not erode. The bottom is sand, which erodes slightly in flood.

Discharge measurements are made by means of a cable, car, and guy wire. The initial point for soundings is the cable support at the right bank.

The gage is an inclined scantling spiked to posts and a tree. Low water (no flow) is 0 on the gage. The highest recorded flood, on September 16, 1904, reached 27 feet on the gage.

The observations during 1905 were made under the direction of the Mexican section of the International (Water) Boundary Commission.

*Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 4 | S. Jaso | 666 | 0.31 | 2.5 | 209 |
| January 9 | do | 659 | .25 | 2.5 | 165 |
| January 14 | do | 626 | .26 | 2.3 | 160 |
| January 18 | do | 621 | .19 | 2.2 | 117 |
| January 21 | do | 618 | .18 | 2.2 | 113 |
| January 26 | do | 600 | .12 | 2.0 | 74 |
| January 30 | do | 614 | .13 | 2.0 | 81 |
| February 4 | do | 591 | .13 | 2.0 | 77 |
| February 8 | do | 601 | .14 | 1.95 | 82 |
| February 12 | do | 543 | .11 | 1.7 | 58 |
| February 16 | do | 545 | .10 | 1.7 | 54 |
| February 20 | do | 583 | .12 | 2.0 | 69 |
| February 24 | do | 636 | .17 | 2.3 | 109 |
| February 28 | do | 587 | .11 | 2.0 | 63 |
| March 4 | do | 567 | .10 | 1.9 | 57 |
| March 6 | do | 817 | .72 | 3.4 | 586 |
| March 8 | do | 1,839 | 1.82 | 7.2 | 3,345 |
| March 13 | do | 609 | .29 | 2.2 | 176 |
| March 17 | do | 658 | .40 | 2.6 | 264 |
| March 21 | do | 630 | .36 | 2.5 | 227 |
| March 25 | do | 596 | .33 | 2.2 | 194 |
| March 29 | do | 552 | .20 | 1.9 | 113 |
| April 3 | do | 614 | .32 | 2.4 | 198 |
| April 7 | do | 453 | .12 | 1.4 | 53 |
| April 12 | do | 486 | .15 | 1.6 | 74 |
| April 20 | do | 434 | .12 | 1.25 | 52 |
| April 24 | do | 748 | .58 | 3.35 | 436 |
| April 28 | do | 493 | .10 | 1.4 | 49 |
| May 3 | do | 414 | .12 | 1.3 | 49 |
| May 8 | do | 1,466 | 1.51 | 6.45 | 2,191 |
| May 9 | do | 877 | .89 | 3.95 | 778 |
| May 12 | do | 448 | .16 | 1.7 | 72 |
| May 17 | do | 344 | .09 | 1.1 | 30 |
| May 22 | do | 308 | .08 | .9 | 25 |
| May 26 | do | 310 | .08 | 1.0 | 26 |
| May 31 | do | 2,431 | 2.53 | 10.25 | 6,142 |
| June 2 | do | 3,736 | 3.92 | 15.65 | 14,663 |
| June 3 | do | 2,794 | 2.41 | 11.7 | 6,741 |
| June 5 | do | 1,283 | 1.98 | 5.65 | 2,541 |
| June 9 | do | 541 | .66 | 3.2 | 355 |
| June 13 | do | 389 | .34 | 2.3 | 132 |
| June 17 | do | 307 | .21 | 1.75 | 66 |
| June 22 | do | 970 | 1.34 | 4.1 | 1,296 |
| June 27 | do | 359 | .44 | 2.55 | 158 |
| July 3 | do | 312 | .22 | 1.8 | 69 |
| July 7 | do | 256 | .10 | 1.3 | 25 |
| July 11 | do | 219 | .07 | 1.0 | 16 |
| July 15 | do | 202 | .07 | .9 | 15 |
| July 16 | do | 491 | .74 | 3.0 | 361 |
| July 18 | do | 3,883 | 4.04 | 16.35 | 15,676 |
| July 19 | do | 1,748 | 2.58 | 10.1 | 4,518 |
| July 25 | do | 288 | .44 | 2.3 | 127 |

*Discharge measurements of Rio San Juan near Santa Rosalia ranch, Tamaulipas, Mexico, in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 31 | S. Jaso | 190 | 0.14 | 1.5 | 27 |
| August 4 | do | 167 | .12 | 1.3 | 20 |
| August 9 | do | 151 | .08 | 1.1 | 12 |
| August 11 | do | 371 | .91 | 2.9 | 338 |
| August 14 | do | 229 | .29 | 1.8 | 66 |
| August 18 | do | 153 | .15 | 1.2 | 23 |
| August 22 | do | 135 | .08 | .9 | 11 |
| August 26 | do | 118 | .08 | .8 | 10 |
| August 30 | do | 108 | .06 | .7 | 7 |
| September 4 | do | 101 | .06 | .5 | 6 |
| September 17 | do | 382 | .90 | 2.8 | 345 |
| September 19 | do | 626 | 2.16 | 4.85 | 1,354 |
| September 20 | do | 3,955 | 4.57 | 16.5 | 18,071 |
| September 21 | do | 2,521 | 3.35 | 13.15 | 8,444 |
| September 25 | do | 653 | 1.77 | 5.05 | 1,155 |
| September 29 | do | 231 | .56 | 2.2 | 129 |
| October 3 | do | 180 | .30 | 1.7 | 54 |
| October 4 | do | 1,485 | 2.68 | 6.55 | 3,973 |
| October 7 | do | 2,620 | 3.52 | 13.65 | 9,230 |
| October 8 | do | 1,761 | 3.28 | 10.2 | 5,781 |
| October 9 | do | 1,386 | 2.35 | 8.0 | 3,262 |
| October 11 | do | 605 | 1.45 | 4.7 | 875 |
| October 13 | do | 1,481 | 2.63 | 8.6 | 3,899 |
| October 16 | do | 580 | 1.30 | 4.5 | 756 |
| October 21 | do | 470 | .82 | 3.3 | 387 |
| October 26 | do | 462 | .82 | 3.2 | 378 |
| November 3 | do | 2,170 | 3.77 | 14.7 | 8,179 |
| November 6 | do | 1,661 | 3.39 | 11.2 | 5,625 |
| November 9 | do | 1,614 | 2.54 | 8.75 | 4,102 |
| November 13 | do | 1,083 | 1.92 | 6.6 | 2,077 |
| November 18 | do | 954 | 1.87 | 5.9 | 1,786 |
| November 21 | do | 1,844 | 2.41 | 10.75 | 4,445 |
| November 27 | do | 917 | 1.42 | 4.9 | 1,305 |
| December 3 | do | 960 | 1.15 | 4.4 | 1,104 |
| December 9 | do | 1,050 | 1.72 | 5.45 | 1,801 |
| December 14 | do | 709 | 1.40 | 4.3 | 990 |
| December 18 | do | 712 | 1.23 | 4.2 | 875 |
| December 22 | do | 638 | 1.14 | 3.9 | 727 |
| December 27 | do | 600 | .98 | 3.7 | 586 |
| December 30 | do | 636 | .76 | 3.6 | 485 |

*Daily gage height, in feet, of Rio San Juan near Santa Rosalia Ranch, Tamaulipas, Mexico, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | 2.0 | 2.0 | 1.7 | 1.4 | 7.4 | 2.05 | 1.5 | 0.6 | 1.95 | 4.75 | 4.6 |
| 2 | 2.6 | 3.25 | 2.0 | 1.7 | 1.35 | 14.1 | 1.95 | 1.4 | .6 | 1.75 | 19.3 | 4.55 |
| 3 | 2.6 | 2.3 | 1.9 | 2.2 | 1.3 | 10.4 | 1.75 | 1.4 | .6 | 3.5 | 14.45 | 4.4 |
| 4 | 2.5 | 2.0 | 1.9 | 1.7 | 1.3 | 10.55 | 1.6 | 1.3 | .5 | 6.6 | 9.95 | 4.3 |
| 5 | 2.5 | 1.9 | 2.6 | 1.6 | 1.3 | 6.0 | 1.5 | 1.3 | .5 | 5.4 | 8.25 | 4.3 |
| 6 | 2.5 | 1.9 | 3.8 | 1.5 | 1.3 | 5.2 | 1.4 | 1.3 | .5 | 4.55 | 10.35 | 4.35 |
| 7 | 2 5 | 1.9 | 4.1 | 1.4 | 1.25 | 4.35 | 1.25 | 1.2 | ....... | 11.9 | 11.7 | 4.5 |
| 8 | 2.5 | 1.9 | 6.6 | 1.4 | 4.6 | 3.45 | 1.1 | 1.3 | ....... | 11.3 | 10.95 | 4.7 |
| 9 | 2.5 | 2.0 | 4.2 | 1.45 | 3.5 | 3.05 | 1.1 | 1.1 | ....... | 7.35 | 8.7 | 5.45 |
| 10 | 2.4 | 1.95 | 3.2 | 1.5 | 2.45 | 2.65 | 1.0 | 1.1 | ....... | 5.45 | 9.35 | 5.3 |
| 11 | 2.4 | 1.85 | 2.45 | 1.6 | 1.95 | 2.55 | 1.0 | 2.95 | ....... | 4.55 | 8.0 | 4.15 |
| 12 | 2.35 | 1.75 | 2.3 | 1.55 | 1.8 | 2.4 | 1.0 | 2.7 | ....... | 6.9 | 6.9 | 4.5 |
| 13 | 2.3 | 1.7 | 2.2 | 1.5 | 1.65 | 2.25 | .95 | 1.95 | ....... | 8.5 | 6.6 | 4.4 |
| 14 | 2.3 | 1.8 | 2.2 | 1.5 | 1.45 | 2.15 | .9 | 1.75 | ....... | 5.65 | 6.6 | 4.3 |
| 15 | 2.2 | 1.8 | 2.65 | 1.4 | 1.3 | 1.95 | .9 | 1.55 | ....... | 4.9 | 6.65 | 4.3 |
| 16 | 2.2 | 1.7 | 2.5 | 1.4 | 1.2 | 1.85 | 2.9 | 1.45 | ....... | 4.45 | 6.5 | 4.25 |
| 17 | 2.2 | 1.7 | 2.8 | 1.4 | 1.1 | 1.7 | 6.2 | 1.35 | 2.35 | 4.1 | 5.85 | 4.2 |
| 18 | 2.2 | 1.7 | 2.85 | 1.3 | 1.1 | 1.6 | 15.2 | 1.15 | 2.5 | 3.85 | 5.75 | 4.2 |
| 19 | 2.2 | 2.15 | 2.7 | 1.3 | 1.05 | 1.55 | 11.45 | 1.1 | 4.0 | 3.65 | 5.65 | 4.1 |
| 20 | 2.2 | 2.0 | 2.6 | 1.25 | 1.0 | 1.5 | 6.15 | 1.0 | 14.5 | 3.55 | 5.55 | 4.1 |
| 21 | 2.2 | 1.95 | 2.5 | 1.2 | .9 | 1.7 | 5.1 | .95 | 11.75 | 3.25 | 9.1 | 3.9 |
| 22 | 2.15 | 2.1 | 2.4 | 1.2 | .9 | 5.65 | 3.25 | .9 | 6.15 | 3.35 | 6.75 | 3.9 |
| 23 | 2.1 | 2.2 | 2.35 | 1.2 | .9 | 4.85 | 2.75 | .9 | 4.3 | 3.45 | 5.95 | 3.9 |
| 24 | 2.1 | 2.3 | 2.3 | 2.25 | .9 | 3.6 | 2.45 | .85 | 3.25 | 3.35 | 5.55 | 3.9 |
| 25 | 2.0 | 2.25 | 2.2 | 2.6 | .95 | 3.3 | 2.25 | .8 | 3.9 | 3.3 | 5.3 | 3.8 |
| 26 | 2.0 | 2.2 | 2.05 | 2.1 | 1.0 | 3.35 | 2.05 | .8 | 3.85 | 3.2 | 5.2 | 3.7 |
| 27 | 2.0 | 2.1 | 2.0 | 1.4 | 1.0 | 3.35 | 1.9 | .7 | 2.75 | 3.1 | 4.9 | 3.7 |
| 28 | 2.0 | 2.0 | 1.95 | 1.35 | 1.0 | 3.15 | 1.8 | .7 | 2.35 | 3.1 | 4.8 | 3.7 |
| 29 | 2.0 | ....... | 1.9 | 1.3 | 1.0 | 2.35 | 1.7 | .7 | 2.15 | 3.0 | 4.7 | 3.6 |
| 30 | 2.0 | ....... | 1.85 | 1.25 | 1.0 | 1.95 | 1.6 | .7 | 2.0 | 3.0 | 4.6 | 3.6 |
| 31 | 2.0 | ....... | 1.7 | ....... | 8.5 | ....... | 1.5 | .7 | ....... | 3.0 | ....... | 3.6 |

NOTE.—No flow September 7-16.

## CONEJOS RIVER NEAR MOGOTE, COLO.

Conejos River is the largest tributary of the Rio Grande in Colorado. Its source is the slopes of Conejos Peak and adjoining mountains, which have a general altitude of 12,000 feet. The general course is very irregular. Half of this course is in canyon, while the lower half is through the broad, almost level San Luis Valley. The lower basin is composed of gravelly mesas which merge into the level valley lands below. Rainfall data collected at Conejos by the United States Weather Bureau for a few months give the mean annual rainfall as 10 inches. The precipitation increases with the altitude to approximately 20 inches in the head waters. Irrigation as heretofore practiced has been very crude, and almost the entire normal flow of the river at low water is required for the numerous small ditches which render cultivation possible.

This station was established August 25, 1899, by A. L. Fellows, and is located 500 feet below the highway bridge 4 miles above Mogote, Colo., in T. 33 N., R. 7 W., New Mexico principal meridian. The nearest railroad station is Antonito, Colo., 12 miles east. This station was discontinued in the fall of 1900 and reestablished in the spring of 1903. The fact that Conejos River is the chief tributary of the Rio Grande in Colorado makes this station of importance, as it is above all diversions, of which there are a great many in Conejos Valley. A number of storage reservoirs are proposed for this basin.

The channel at the gage has a very gentle curve, and the bed is composed of small bowlders and cobblestones. The banks are low, of alluvial material, and will overflow during very high water. At extremely high stages, water passes through low depressions around both sides of the channel and is not registered on the gage. Such was the case during the extreme high water of June, 1905. The velocity is moderate at low water at this section. At the highway bridge above the gage the channel is 90 feet in width, with a 9-foot crib pier breaking the current at the center of stream. The section is not uniform, and is composed of bowlders and cobblestones. During the high water of June a considerable volume of water passed around the right end, running over the bridge to a depth of about 6 inches. This high water also eroded the channel greatly and changed its alignment for 1 mile above and many miles below. During August and the remaining portion of the year this section was partially obstructed by a temporary rock and log dam extending at a slight angle upstream and under the left span of the bridge. This dam was for the purpose of diverting water for irrigation and will probably go out with high water. At low water the velocity is moderate at the station, and at high stages it is very swift.

Discharge measurements are made at the gage rod during low water, and from the downstream side of the highway bridge during high water. The initial point for soundings is the face of the right abutment.

The gage is an inclined staff fastened to a large stump on the left bank of the river at Mr. King's ranch. Gage heights range from 1 to 6 feet on the gage. During 1905 the gage was read twice each day by Miss Nellie King. The bench mark is the center of three 20-penny nails driven into the base of a large cottonwood tree, 300 feet south of gage; elevation, 7.87 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 37, pp 278-279; 50, p 348; 99, p 397; 132, p 94.
Discharge: WS 37, p 279; 50, p 348; 99, p 398; 132, p 95.
Discharge, monthly: Ann 22, iv, p 348; 99, p 399; 132, p 96.
Gage heights: WS 37, p 279; 50, p 348; 99, p 398; 132, p 95.
Rating tables: WS 52, p 519; 99, p 399; 132 p 96.
Seepage computations: WS 50, p 306.

*Discharge measurements of Conejos River near Mogote, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 21 | R. I. Meeker | 76 | 162 | 2.01 | 2.20 | 328 |
| June 22 | do | 81 | 289 | 4.69 | 3.65 | 1,356 |
| July 27 | do | 66 | 151 | 1.64 | 2.00 | 246 |
| September 19[a] | do | 65 | 61 | 1.02 | 1.30 | 62 |

[a] Wading at gage rod.

*Daily gage height, in feet, of Conejos River near Mogote, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.65 | 3.4 | 4.8 | 3.2 | 1.7 | 1.7 | 1.6 |
| 2 | 1.4 | 3.4 | 5.1 | 3.0 | 2.2 | 1.6 | 1.55 |
| 3 | 1.5 | 3.0 | 5.15 | 3.0 | 2.25 | 1.5 | 1.5 |
| 4 | 1.55 | 2.8 | 5.55 | 3.35 | 2.4 | 1.5 | 1.4 |
| 5 | 1.6 | 2.7 | 5.65 | 3.6 | 2.1 | 1.55 | 1.4 |
| 6 | 1.6 | 2.55 | 4.4 | 3.65 | 2.2 | 1.55 | 1.4 |
| 7 | 1.75 | 2.7 | 5.05 | 2.35 | 2.2 | 1.6 | 1.35 |
| 8 | 1.85 | 2.85 | 5.35 | 2.65 | 2.15 | 1.5 | 1.3 |
| 9 | 2.0 | 3.0 | 5.05 | 2.4 | 2.05 | 1.5 | 1.3 |
| 10 | 2.1 | 2.85 | 4.9 | 2.55 | 1.9 | 1.5 | 1.3 |
| 11 | 2.0 | 2.75 | 4.85 | 2.55 | 2.25 | 1.5 | 1.2 |
| 12 | 2.0 | 2.75 | 4.7 | 2.45 | 2.1 | 1.4 | 1.2 |
| 13 | 2.05 | 3.0 | 4.7 | 2.4 | 1.9 | 1.4 | 1.2 |
| 14 | 2.0 | 3.1 | 4.6 | 2.4 | 1.9 | 1.4 | 1.2 |
| 15 | 2.1 | 3.55 | 4.7 | 2.5 | 1.8 | 1.4 | 1.2 |
| 16 | 2.05 | 3.9 | 4.55 | 2.5 | 1.7 | 1.4 | 1.2 |
| 17 | 2.15 | 4.15 | 4.3 | 2.3 | 1.7 | 1.3 | 1.3 |
| 18 | 2.2 | 4.3 | 4.2 | 2.2 | 1.65 | 1.35 | 1.3 |
| 19 | 2.35 | 4.35 | 4.1 | 2.25 | 1.6 | 1.3 | 1.3 |
| 20 | 2.2 | 4.45 | 3.95 | 2.4 | 1.65 | 1.3 | 1.3 |
| 21 | 2.25 | 4.45 | 3.8 | 2.45 | 1.6 | 1.3 | 1.3 |
| 22 | 2.35 | 4.5 | 3.7 | 2.45 | 1.6 | 1.3 | 1.3 |
| 23 | 2.3 | 4.6 | 3.8 | 2.4 | 1.6 | 1.3 | 1.4 |
| 24 | 2.2 | 4.75 | 3.7 | 2.2 | 1.6 | 1.25 | 1.5 |
| 25 | 2.2 | 4.75 | 3.6 | 2.1 | 1.8 | 1.25 | 1.5 |
| 26 | 2.3 | 4.85 | 3.55 | 2.0 | 1.7 | 1.4 | 1.4 |
| 27 | 2.5 | 4.8 | 3.55 | 2.05 | 1.7 | 1.4 | 1.4 |
| 28 | 2.7 | 4.6 | 3.5 | 2.2 | 1.65 | 1.4 | 1.4 |
| 29 | 2.9 | 4.05 | 3.4 | 2.4 | 1.75 | 1.4 | 1.4 |
| 30 | 3.05 | 4.25 | 3.3 | 2.3 | 1.7 | 1.65 | 1.4 |
| 31 | ........ | 4.5 | ........ | 2.15 | 1.7 | ........ | 1.4 |

*Station rating table for Conejos River near Mogote, Colo., from April 1 to June 5, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 25 | 2.40 | 425 | 3.40 | 1,120 | 4.40 | 2,180 |
| 1.50 | 55 | 2.50 | 480 | 3.50 | 1,210 | 4.50 | 2,300 |
| 1.60 | 85 | 2.60 | 540 | 3.60 | 1,310 | 4.60 | 2,430 |
| 1.70 | 120 | 2.70 | 600 | 3.70 | 1,410 | 4.70 | 2,560 |
| 1.80 | 155 | 2.80 | 660 | 3.80 | 1,510 | 4.80 | 2,690 |
| 1.90 | 190 | 2.90 | 725 | 3.90 | 1,610 | 4.90 | 2,820 |
| 2.00 | 230 | 3.00 | 795 | 4.00 | 1,720 | 5.00 | 2,950 |
| 2.10 | 275 | 3.10 | 870 | 4.10 | 1,830 | 5.20 | 3,230 |
| 2.20 | 320 | 3.20 | 950 | 4.20 | 1,940 | 5.40 | 3,510 |
| 2.30 | 370 | 3.30 | 1,030 | 4.30 | 2,060 | 5.60 | 3,800 |

The above table is applicable only for open channel conditions. It is based on one discharge measurement made during 1905 and on 1904 measurements. It is not well defined.

*Station rating table for Conejos River near Mogote, Colo., from June 6 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 45 | 2.30 | 375 | 3.40 | 1,120 | 4.50 | 2,300 |
| 1.30 | 60 | 2.40 | 425 | 3.50 | 1,210 | 4.60 | 2,430 |
| 1.40 | 80 | 2.50 | 480 | 3.60 | 1,310 | 4.70 | 2,560 |
| 1.50 | 100 | 2.60 | 540 | 3.70 | 1,410 | 4.80 | 2,690 |
| 1.60 | 125 | 2.70 | 600 | 3.80 | 1,510 | 4.90 | 2,820 |
| 1.70 | 155 | 2.80 | 660 | 3.90 | 1,610 | 5.00 | 2,950 |
| 1.80 | 185 | 2.90 | 725 | 4.00 | 1,720 | 5.10 | 3,090 |
| 1.90 | 215 | 3.00 | 795 | 4.10 | 1,830 | 5.20 | 3,230 |
| 2.00 | 250 | 3.10 | 870 | 4.20 | 1,940 | 5.30 | 3,370 |
| 2.10 | 290 | 3.20 | 950 | 4.30 | 2,060 | 5.40 | 3,510 |
| 2.20 | 330 | 3.30 | 1,030 | 4.40 | 2,180 | | |

The above table is applicable only for open channel conditions. It is based on three discharge measurements made during 1905. It is not well defined.

*Estimated monthly discharge of Conejos River near Mogote, Colo., for 1905.*

[Drainage area, 282 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 832 | 25 | 297 | 17,670 | 1.05 | 1.17 |
| May | 2,755 | 510 | 1,544 | 94,940 | 5.48 | 6.32 |
| June | 3,875 | 1,030 | 2,226 | 132,500 | 7.89 | 8.80 |
| July | 1,360 | 250 | 528 | 32,460 | 1.87 | 2.16 |
| August | 425 | 125 | 213 | 13,100 | .755 | .870 |
| September | 155 | 52 | 87.4 | 5,201 | .310 | .346 |
| October | 125 | 45 | 71.5 | 4,396 | .254 | .293 |
| The period | | | | 300,300 | | |

## PECOS RIVER AT SANTA ROSA, N. MEX.

This station was established May 5, 1903, by H. C. Hurd. It was originally located at the bridge of the Chicago, Rock Island and Pacific Railway, but was moved later in the year to a point 335 feet above the railway bridge.

The bed of the river is solid rock, overlaid by quicksand to the depth of 2 or 3 feet in the long dry season. The current is never sluggish and becomes very swift during the time of floods. The channel is straight for one-fourth mile above and below the station. Both banks are high and can not overflow.

Discharge measurements are made by means of a cable. The initial point for soundings is the left end of the cable.

The original gage was a staff bolted to the masonry footing of the east tower. During the great flood of September 29 and 30, 1904, the upper portion of the gage rod was torn away, but the lower portion was left intact. A new gage was installed on the east side of the second pier to replace the one which was torn out. This new portion of the gage is bolted to the east face of the second pier from the north end of the bridge. The same flood cut away the earth from the face of the north abutment, leaving the bench mark about 25 feet above the ground and inaccessible, so in establishing the new gage reference was made to the old gage which had not been moved by the flood. During 1905 the gage was read once each day by L. M. Shely. Bench marks were established as follows: (1) A shelf cut in the east abutment; elevation, 29.70 feet. (2) A chiseled surface on the east side of the first pier from the north end of the bridge, near the top of the second stone from the downstream end of the pier, in the second tier of stones from the bed rock, marked "B. M."; elevation, 6.41 feet. (3) The top of the downstream end of retaining wall on the east side of the river; elevation, 14.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 363-364; 132, p 97.
Discharge: 99, p 364; 132, p 97.
Gage heights: 99, pp 364-365; 132, p 98.

*Discharge measurements of Pecos River at Santa Rosa, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage Height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second feet.* |
| May 2 | J. M. Giles | 96 | 236 | 5.61 | 2.50 | 1,321 |
| June 2 | E. Patterson | 93 | 196 | 5.28 | 2.10 | 1,035 |
| June 5 | do | 93 | 195 | 5.88 | 2.30 | 1,145 |
| July 3 | do | 78 | 37 | 1.49 | 1.10 | 55 |
| July 7 | do | 26 | 14 | 1.03 | .80 | 14.5 |
| August 21 | Giles and Patterson | 25 | 12 | 1.19 | .72 | 14.8 |
| August 23 | E. Patterson | 24 | 12 | 1.16 | .71 | 13.9 |
| October 8 | do | 24 | 11 | 1.09 | .81 | 12 |
| October 24 | J. M. Giles | 26 | 13 | 1.16 | .80 | 15 |
| November 17 | E. Patterson | 18 | 10 | 1.19 | .87 | 12 |

*Daily gage height, in feet, of Pecos River at Santa Rosa, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 0.5 | 1.5 | 1.0 | 1.5 | 2.6 | 1.5 | 1.2 | 0.7 | 0.7 | 0.8 | 1.5 |
| 2 | .5 | .5 | 1.6 | 1.0 | 2.5 | 2.1 | 1.5 | 3.0 | .7 | .7 | .8 | 1.0 |
| 3 | .5 | .5 | 2.0 | 1.0 | 2.5 | 2.0 | 1.5 | 2.5 | .7 | .7 | .8 | 1.0 |
| 4 | .5 | .5 | 2.0 | 1.0 | 2.5 | 3.05 | 1.0 | 2.5 | 1.5 | .7 | .8 | 1.0 |
| 5 | .5 | .5 | 2.5 | 1.0 | 2.5 | 2.2 | .9 | 2.0 | 1.5 | .7 | .8 | .8 |
| 6 | .5 | .5 | 3.0 | 1.0 | 2.5 | 2.1 | .8 | 2.0 | 1.0 | .7 | .8 | .8 |
| 7 | .5 | .5 | 3.0 | 1.0 | 3.0 | 1.9 | .8 | 1.5 | .9 | .7 | .9 | .8 |
| 8 | .5 | .6 | 2.0 | 1.5 | 2.5 | 2.0 | .8 | 1.5 | .9 | .7 | .8 | .8 |
| 9 | .5 | .6 | 2.0 | 1.5 | 2.5 | 3.0 | .8 | 1.5 | .9 | .8 | 1.0 | .8 |
| 10 | .5 | .6 | 2.0 | 1.5 | 2.5 | 2.3 | .8 | 1.5 | .9 | .8 | 1.1 | .8 |
| 11 | .5 | .6 | 2.0 | 2.5 | 2.5 | 2.0 | .7 | 1.5 | .9 | .8 | .9 | .8 |
| 12 | .5 | .6 | 1.5 | 2.5 | 2.5 | 2.5 | .7 | 2.5 | 1.3 | .8 | .9 | .8 |
| 13 | .5 | .6 | 1.5 | 1.5 | 2.5 | 2.5 | .7 | 2.0 | 1.0 | .8 | .9 | .8 |
| 14 | .5 | .6 | 1.5 | 1.5 | 3.0 | 2.0 | .7 | 1.5 | 1.0 | .8 | .9 | .9 |
| 15 | .4 | .6 | 1.4 | 1.5 | 2.5 | 1.7 | .7 | 1.5 | 1.0 | .8 | .9 | .8 |
| 16 | .4 | .6 | 1.4 | 1.5 | 2.5 | 1.7 | .7 | 1.5 | 1.0 | .8 | .9 | .6 |
| 17 | .4 | .6 | 1.4 | 1.5 | 2.5 | 1.0 | .7 | 1.0 | .8 | .8 | .9 | .6 |
| 18 | .4 | .6 | 1.4 | 1.5 | 2.5 | 1.0 | .7 | .9 | .8 | .8 | .9 | .6 |
| 19 | .4 | .6 | 1.4 | 1.5 | 2.5 | 1.0 | .7 | .8 | .8 | .8 | .9 | .5 |
| 20 | .4 | .8 | 1.4 | 1.5 | 2.5 | 1.0 | .7 | .7 | .7 | .8 | .9 | .5 |
| 21 | .4 | .8 | 1.4 | 1.5 | 2.5 | 1.0 | .9 | .7 | .7 | .8 | .9 | .5 |
| 22 | .4 | 1.0 | 1.4 | 1.5 | 2.5 | 1.0 | 2.5 | .7 | .7 | .8 | .9 | .5 |
| 23 | .4 | 1.5 | 1.4 | 3.5 | 2.5 | 1.0 | 1.5 | .7 | .7 | .8 | 4.0 | .5 |
| 24 | .4 | 1.5 | 1.4 | 3.0 | 2.8 | 1.0 | 1.5 | .7 | .7 | .8 | 2.5 | .5 |
| 25 | .4 | 3.0 | 1.4 | 3.0 | 3.0 | 1.0 | 1.5 | .7 | .7 | .8 | 1.5 | .6 |
| 26 | .4 | 1.5 | 1.4 | 2.5 | 2.5 | 1.5 | 1.0 | .7 | .7 | .8 | 1.5 | .6 |
| 27 | .4 | 1.5 | 1.4 | 2.5 | 2.5 | 1.5 | 1.0 | .7 | .7 | .8 | 3.0 | .6 |
| 28 | .4 | 1.5 | 1.4 | 2.5 | 2.5 | 1.5 | 1.0 | .7 | .7 | .8 | 1.0 | .6 |
| 29 | .5 | ...... | 1.4 | 2.5 | 2.5 | 1.5 | 1.0 | .7 | .7 | .8 | 2.0 | .6 |
| 30 | .5 | ...... | 1.4 | 3.0 | 2.5 | 1.5 | 1.0 | .7 | 7 | .8 | 1.6 | .3 |
| 31 | .5 | ...... | 1.4 | ...... | 2.0 | ...... | 1.0 | .7 | ...... | .8 | ...... | .6 |

## PECOS RIVER NEAR FORT SUMNER, N. MEX.

This station was established June 12, 1904, by Earl Patterson. It is located about 12 miles northwest of Fort Sumner, N. Mex., and 45 miles south of Santa Rosa, N. Mex., the nearest railway station. It was originally located 1 mile upstream from the spring, trees, and houses known as Arinosa, but was relocated July 5, 1905, near the spring.

Both banks are high and will not overflow except in extreme high water. The bed of the river is clean, shifting sand.

Discharge measurements are made by wading at or near the gage.

The gage is an inclined staff bolted to a ledge of sandstone on the right bank. During 1905 the gage was read twice each day by J. C. Pacheco. Bench marks were established as follows: (1) The head of a bolt set in the rock 14 feet upstream from gage; elevation, 7.48 feet. (2) A cross cut in the sandstone ledge 5 feet downstream from gage; elevation, 7.11 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 132 of the United States Geological Survey, pp. 98101.

*Discharge measurements of Pecos River near Fort Sumner, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second feet.* |
| July 4 | E. Patterson | 84 | 68 | 1.56 | 1.40 | 107 |
| July 6 | do | 91 | 55 | 1.55 | 1.30 | 86 |
| August 22 | Giles and Patterson | 46 | 52 | 1.64 | 1.40 | 85 |
| October 9 | E. Patterson | 75 | 62 | 1.48 | 1.45 | 92 |
| November 18 | do | 80 | 59 | 1.60 | 1.50 | 95 |
| (a) | J. M. Giles | | 200 | 1.76 | 2.00 | 352 |
| (a) | do | | 405 | 2.70 | 3.00 | 1,093 |
| (a) | do | | 615 | 3.36 | 4.00 | 2,066 |

[a] Computed from slope measurement, using Kutter's formula.

*Daily gage height, in feet, of Pecos River near Fort Sumner, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.4 | 0.3 | 2.95 | 1.3 | 2.3 | 2.3 | 1.4 | 1.8 | 1.4 | 1.4 | 1.55 | 1.75 |
| 2 | .4 | .3 | 2.6 | 1.35 | 2.4 | 2.2 | 1.7 | 1.5 | 1.4 | 1.4 | 1.5 | 1.8 |
| 3 | .4 | .3 | 2.25 | 1.3 | 2.45 | 2.25 | 1.55 | 2.0 | 1.4 | 1.4 | 1.55 | 1.75 |
| 4 | .4 | .8 | 2.0 | 1.3 | 2.4 | 1.95 | 1.45 | 1.72 | 1.4 | 1.4 | 1.65 | 1.65 |
| 5 | .4 | .8 | .85 | 1.2 | 2.2 | 2.8 | 1.4 | 2.22 | 3.2 | 1.4 | 1.55 | 1.65 |
| 6 | .4 | .8 | .75 | 1.3 | 2.15 | 2.3 | 1.3 | 1.87 | 1.6 | 1.4 | 1.6 | 1.65 |
| 7 | .4 | .8 | .7 | 1.3 | 1.95 | 2.25 | 1.4 | 1.87 | 1.5 | 1.4 | 1.6 | 1.75 |
| 8 | .4 | .9 | 1.1 | 1.2 | 2.05 | 2.1 | 1.35 | 2.15 | 1.6 | 1.4 | 1.6 | 1.7 |
| 9 | .4 | .7 | 1.0 | 1.2 | 2.25 | 2.4 | 1.4 | 1.85 | 1.6 | 1.45 | 1.7 | 1.65 |
| 10 | .4 | .6 | 1.25 | 1.2 | 2.3 | 2.45 | 1.4 | 1.77 | 1.5 | 1.5 | 1.7 | 1.6 |
| 11 | .4 | .6 | 1.3 | 1.35 | 2.3 | 2.6 | 1.4 | 1.7 | 1.7 | 1.5 | 1.7 | 1.75 |
| 12 | .4 | .6 | 1.2 | 1.6 | 2.2 | 2.35 | 1.4 | 1.9 | 1.5 | 1.45 | 1.65 | 1.8 |
| 13 | .4 | .6 | 1.2 | 1.7 | 2.0 | 2.3 | 1.4 | 2.3 | 1.5 | 1.45 | 1.6 | 1.95 |
| 14 | .4 | .6 | 1.2 | 1.4 | 2.05 | 2.35 | 1.4 | 1.77 | 1.45 | 1.45 | 1.6 | 1.7 |
| 15 | .4 | .6 | 1.2 | 1.4 | 2.15 | 2.2 | 1.4 | 1.52 | 1.45 | 1.45 | 1.55 | 1.75 |
| 16 | .4 | .6 | 1.2 | 1.5 | 2.2 | 2.1 | 1.35 | 1.5 | 1.4 | 1.4 | 1.6 | 1.7 |
| 17 | .4 | .6 | 1.15 | 1.5 | 2.35 | 1.9 | 1.35 | 1.47 | 1.35 | 1.45 | 1.55 | 1.7 |
| 18 | .3 | .6 | 1.1 | 1.45 | 2.4 | 1.8 | 1.35 | 1.42 | 1.3 | 1.45 | 1.5 | 1.7 |
| 19 | .3 | .6 | 1.0 | 1.75 | 2.55 | 1.9 | 1.35 | 1.42 | 1.35 | 1.4 | 1.5 | 1.75 |
| 20 | .3 | .5 | .9 | 1.6 | 3.1 | 1.8 | 1.35 | 1.4 | 1.35 | 1.4 | 1.55 | 1.75 |
| 21 | .3 | .6 | .8 | 1.7 | 2.95 | 1.8 | 1.4 | 1.4 | 1.3 | 1.4 | 1.6 | 1.7 |
| 22 | .3 | .7 | 1.1 | 1.7 | 2.5 | 1.9 | 2.1 | 1.4 | 1.3 | 1.4 | 1.65 | 1.6 |
| 23 | .3 | 1.3 | 1.0 | 2.7 | 3.3 | 1.75 | 2.0 | 1.4 | 1.35 | 1.45 | 2.2 | 1.5 |
| 24 | .4 | 1.55 | .9 | 2.95 | 2.75 | 1.7 | 1.7 | 1.45 | 1.35 | 1.45 | 2.7 | 2.25 |
| 25 | .4 | 1.2 | .8 | 2.95 | 2.9 | 1.7 | 1.6 | 1.45 | 1.35 | 1.5 | 2.1 | 1.95 |
| 26 | .4 | 1.05 | .8 | 2.4 | 2.25 | 1.7 | 1.6 | 1.4 | 1.35 | 1.5 | 1.75 | 1.85 |
| 27 | .4 | .9 | .9 | 2.2 | 2.25 | 1.6 | 1.6 | 1.4 | 1.35 | 1.5 | 1.6 | 1.85 |
| 28 | .4 | .9 | .95 | 2.45 | 2.5 | 1.6 | 1.5 | 1.4 | 1.45 | 1.5 | 1.7 | 1.8 |
| 29 | .4 | ....... | 1.0 | 2.45 | 2.4 | 1.6 | 1.5 | 1.4 | 1.4 | 1.5 | 1.85 | 1.8 |
| 30 | .3 | ....... | 1.1 | 2.35 | 2.4 | 1.5 | 1.52 | 1.4 | 1.5 | 1.6 | 2.1 | 1.75 |
| 31 | .3 | ....... | 1.0 | ....... | 2.3 | ....... | 1.45 | 1.4 | ....... | 1.55 | ....... | 2.4 |

*Daily discharge, in second-feet, of Pecos River near Fort Sumner, N. Mex., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | ........ | 260 | 85 | 90 | 120 | 225 |
| 2 | ........ | 120 | 85 | 90 | 110 | 260 |
| 3 | ........ | 360 | 85 | 90 | 115 | 225 |
| 4 | ........ | 220 | 85 | 90 | 135 | 180 |
| 5 | 105 | 490 | 1,250 | 90 | 110 | 180 |
| 6 | 85 | 295 | 170 | 90 | 120 | 180 |
| 7 | 105 | 295 | 130 | 90 | 115 | 225 |
| 8 | 95 | 450 | 170 | 90 | 110 | 200 |
| 9 | 105 | 285 | 170 | 95 | 130 | 180 |
| 10 | 105 | 245 | 130 | 105 | 130 | 140 |
| 11 | 105 | 210 | 215 | 105 | 130 | 210 |
| 12 | 105 | 310 | 130 | 95 | 120 | 240 |
| 13 | 105 | 550 | 130 | 95 | 110 | 325 |
| 14 | 105 | 245 | 117 | 95 | 110 | 200 |
| 15 | 105 | 128 | 117 | 95 | 100 | 210 |
| 16 | 95 | 120 | 105 | 90 | 105 | 200 |
| 17 | 95 | 110 | 95 | 95 | 100 | 200 |
| 18 | 95 | 90 | 85 | 95 | 95 | 200 |
| 19 | 95 | 90 | 85 | 90 | 95 | 210 |
| 20 | 95 | 85 | 95 | 90 | 100 | 210 |
| 21 | 105 | 85 | 85 | 90 | 105 | 190 |
| 22 | 420 | 85 | 85 | 90 | 115 | 140 |
| 23 | 360 | 85 | 95 | 95 | 480 | 95 |
| 24 | 215 | 102 | 95 | 95 | 825 | 500 |
| 25 | 170 | 102 | 95 | 105 | 420 | 325 |
| 26 | 170 | 85 | 95 | 105 | 230 | 265 |
| 27 | 170 | 85 | 97 | 105 | 157 | 265 |
| 28 | 130 | 85 | 117 | 105 | 210 | 240 |
| 29 | 130 | 85 | 105 | 105 | 280 | 240 |
| 30 | 130 | 85 | 130 | 160 | 420 | 210 |
| 31 | 117 | 85 | ........ | 130 | ........ | 600 |

NOTE.—Daily discharge determined by indirect method as applied to shifting channels. As no measurements were made prior to July 4, no estimates have been made for that period.

*Estimated monthly discharge of Pecos River near Fort Sumner, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| July 5-31 | 420 | 85 | 138 | 7,391 |
| August | 550 | 85 | 191 | 11,740 |
| September | 1,250 | 85 | 151 | 8,985 |
| October | 160 | 90 | 98.4 | 6,050 |
| November | 825 | 95 | 183 | 10,890 |
| December | 600 | 95 | 235 | 14,450 |
| The period | .......... | .......... | .......... | 59,510 |

## PECOS RIVER NEAR ROSWELL, N. MEX.

This station was established April 24, 1903, by W. M. Reed. It is located at the highway bridge 8 miles southeast of Roswell, N. Mex., and about 200 feet below the mouth of Hondo River.

The channel is straight for one-half mile above and below the station and has a width at low water of about 50 feet and at ordinary high water of 430 feet. The channel is broken by two iron piers. The current is rapid except near the mouth of Hondo River, where it becomes sluggish. At high water the Pecos and the Hondo join above the bridge. The gage heights on the Pecos may be affected by back water at periods when the Pecos is low and the Hondo is high. Both banks are high and free from timber, but they overflow at extreme flood stages. The bed is sandy and shifting, and the cross section changes during each flood.

Discharge measurements are made from the highway bridge. The initial point for soundings is a zero marked on the guard rail at the west end and north side of the bridge.

The original gage is painted on the right side of the right pier of the bridge. September 15, 1905, a standard chain was bolted to the upstream fencing of the bridge 325 feet from the initial point for soundings; length of chain, 26.45 feet. During 1905 the gage was read twice each day by Miss Dovie Goldsmith. Bench marks were established as follows: (1) The top of the pier upon which the original gage is painted; elevation, 20.10 feet. (2) The top of angle bar connecting fencing with first upright east of pier on which the gage is painted; elevation, 25.17 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 360; 132, p 101.
Discharge: 99, p 360; 132, p 102.
Gage heights: 99, p 361; 132, p 102.

*Discharge measurements of Pecos River near Roswell, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 28 | E. Patterson | 290 | 433 | 2.10 | 2.90 | 910 |
| March 28 | F. S. Dobson | 164 | 260 | 1.65 | 2.00 | 431 |
| April 12 | Giles and Mitchell | 176 | 274 | 2.21 | 2.55 | 605 |
| April 26 | E. Patterson | 317 | 729 | 4.53 | 4.50 | 3,305 |
| April 28 | do | 304 | 415 | 3.13 | 3.40 | 1,300 |
| May 23 | do | 364 | 682 | 4.48 | 4.50 | 3,059 |
| June 14 | do | 362 | 535 | 2.92 | 3.70 | 1,565 |
| July 10 | do | 106 | 74 | .85 | 2.30 | 63 |
| July 18 | do | 36 | 39 | .81 | 1.90 | 32 |
| July 24 | do | 370 | 765 | 4.74 | 5.80 | 3,631 |
| July 25 | do | 371 | 1,300 | 5.25 | 6.80 | 6,821 |
| July 27 | do | 223 | 618 | 4.47 | 4.50 | 2,761 |
| August 2 | J. M. Giles | 210 | 377 | 1.90 | 3.40 | 721 |
| August 9 | E. Patterson | 379 | 498 | 3.26 | 3.80 | 1,625 |
| August 26 | do | 112 | 133 | .80 | 1.80 | 106 |
| August 28 | do | 120 | 108 | .71 | 1.70 | 77 |
| September 4 | do | 104 | 96 | .76 | 1.70 | 74 |
| September 6 | do | 219 | 1,063 | 5.88 | 5.90 | 6,259 |
| September 7 | do | 204 | 541 | 2.45 | 3.50 | 1,327 |
| September 8 | do | 214 | 430 | 3.10 | 3.60 | 1,336 |
| September 9 | do | 150 | 198 | 2.38 | 2.80 | 472 |
| September 11 | do | 137 | 187 | 2.19 | 2.75 | 409 |
| October 4 | do | 102 | 113 | 1.35 | 2.45 | 153 |
| October 13 | do | 101 | 85 | 1.04 | 2.25 | 89 |
| October 13 | J. M. Giles | 90 | 92 | 1.14 | 2.25 | 105 |
| October 23 | E. Patterson | 101 | 89 | 1.07 | 2.30 | 97 |
| October 30 | do | 100 | 93 | 1.04 | 2.30 | 97 |
| November 5 | do | ........ | 270 | 1.23 | 3.00 | 333 |
| November 10 | do | ........ | 328 | 1.93 | 3.00 | 634 |
| November 24 | J. M. Giles | ........ | 710 | 3.20 | 4.10 | 2,273 |
| November 25 | do | ........ | 686 | 2.81 | 4.00 | 1,928 |
| December 11 | E. Patterson | 180 | 308 | 1.28 | 2.60 | 398 |

*Daily gage height, in feet, of Pecos River near Roswell, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.2 | 2.5 | 2.3 | 3.3 | 3.5 | 2.5 | 3.3 | 1.8 | 2.1 | 2.5 | 3.5 |
| 2 | 1.2 | 1.2 | 2.5 | 3.0 | 3.35 | 3.4 | 2.5 | 3.0 | 1.8 | 2.1 | 2.5 | 3.2 |
| 3 | 1.2 | 1.2 | 2.3 | 2.45 | 3.2 | 3.4 | 2.5 | 4.0 | 1.8 | 2.2 | 2.6 | 3.2 |
| 4 | 1.2 | 1.2 | 2.3 | 2.3 | 3.2 | 3.4 | 2.5 | 3.3 | 1.8 | 2.4 | 3.0 | 3.0 |
| 5 | 1.0 | 1.3 | 2.9 | 2.3 | 3.2 | 3.4 | 2.5 | 3.2 | 1.8 | 2.4 | 3.0 | 2.8 |
| 6 | 1.0 | 1.3 | .2.3 | 2.35 | 3.2 | 4.5 | 2.5 | 3.2 | 7.5 | 2.3 | 3.0 | 2.6 |
| 7 | 1.0 | 2.0 | 2.5 | 2.45 | 3.45 | 5.0 | 2.4 | 3.2 | 3.7 | 2.3 | 3.0 | 2.6 |
| 8 | 1.0 | 2.0 | 4.0 | 2.45 | 3.35 | 4.0 | 2.4 | 3.0 | 3.6 | 2.3 | 3.0 | 2.6 |
| 9 | 1.0 | 2.2 | 3.0 | 2.4 | 3.35 | 3.5 | 2.3 | 3.8 | 2.9 | 2.2 | 3.3 | 2.6 |
| 10 | 1.6 | 2.2 | 3.0 | 2.4 | 3.2 | 3.5 | 2.3 | 3.4 | 3.7 | 2.2 | 3.0 | 2.6 |
| 11 | 2.0 | 2.0 | 3.9 | 2.45 | 3.1 | 4.0 | 2.3 | 3.4 | 3.0 | 2.2 | 3.0 | 2.7 |
| 12 | 2.0 | 2.0 | 3.0 | 2.5 | 3.5 | 4.0 | 2.3 | 3.3 | 2.5 | 2.2 | 3.0 | 2.7 |
| 13 | 2.6 | 2.4 | 3.0 | 2.5 | 3.45 | 4.4 | 2.2 | 3.2 | 2.45 | 2.2 | 3.0 | 2.7 |
| 14 | 2.0 | 2.4 | 2.9 | 2.45 | 3.35 | 3.7 | 2.2 | 3.2 | 2.45 | 2.1 | 2.8 | 2.7 |
| 15 | 1.1 | 2.0 | 2.9 | 2.45 | 3.25 | 3.5 | 2.2 | 3.2 | 2.45 | 2.1 | 2.8 | 2.7 |
| 16 | 1.6 | 2.6 | 2.8 | 2.45 | 3.25 | 3.5 | 2.0 | 2.8 | 2.4 | 2.1 | 2.8 | 2.7 |
| 17 | 1.4 | 2.8 | 2.6 | 2.45 | 3.3 | 3.5 | 2.0 | 2.6 | 2.4 | 2.1 | 2.8 | 2.7 |
| 18 | 1.0 | 2.7 | 2.6 | 2.45 | 3.45 | 3.5 | 2.0 | 2.5 | 2.4 | 2.1 | 2.8 | 2.5 |
| 19 | 1.0 | 2.5 | 2.3 | 2.45 | 3.45 | 3.5 | 6.2 | 2.3 | 2.3 | 2.1 | 2.6 | 2.5 |
| 20 | 1.6 | 2.3 | 2.2 | 2.45 | 3.5 | 3.5 | 3.3 | 2.3 | 2.2 | 2.1 | 2.6 | 2.5 |
| 21 | 2.0 | 2.6 | 2.0 | 2.45 | 3.8 | 3.5 | 3.0 | 2.0 | 2.2 | 2.1 | 2.6 | 2.5 |
| 22 | 2.4 | 2.6 | 2.0 | 2.45 | 4.45 | 3.5 | 3.0 | 2.0 | 2.2 | 2.1 | 2.6 | 2.5 |
| 23 | 2.4 | 2.0 | 2.0 | 5.35 | 4.45 | 3.5 | 10.0 | 2.0 | 2.2 | 2.1 | 2.6 | 2.5 |
| 24 | 2.4 | 2.0 | 2.0 | 5.0 | 4.45 | 3.3 | 6.0 | 2.0 | 2.2 | 2.1 | 4.75 | 2.5 |
| 25 | 2.0 | 2.6 | 2.0 | 4.0 | 4.45 | 3.3 | 6.7 | 1.8 | 2.1 | 2.1 | 3.85 | 2.5 |
| 26 | 2.0 | 3.6 | 2.6 | 4.45 | 4.45 | 3.3 | 5.6 | 1.8 | 2.1 | 2.3 | 3.5 | 2.5 |
| 27 | 1.1 | 3.0 | 2.4 | 3.75 | 4.45 | 3.3 | 4.3 | 1.8 | 2.1 | 2.3 | 3.3 | 2.5 |
| 28 | 1.8 | 2.5 | 2.0 | 3.3 | 4.0 | 3.3 | 3.8 | 1.8 | 2.1 | 2.4 | 3.0 | 2.5 |
| 29 | 1.3 | ....... | 2.0 | 3.3 | 3.7 | 3.3 | 3.4 | 1.8 | 2.1 | 2.4 | 2.8 | 2.4 |
| 30 | 1.2 | ....... | 2.0 | 3.3 | 3.7 | 3.0 | 3.4 | 1.8 | 2.1 | 2.45 | 3.5 | 2.4 |
| 31 | 1.2 | ....... | 2.0 | ....... | 3.5 | ....... | 3.4 | 1.8 | ....... | 2.45 | ....... | 2.4 |

## PECOS RIVER NEAR DAYTON, N. MEX.

This station was established March 24, 1905. It was located about 3 miles east of Dayton, N. Mex., 100 feet below the mouth of Penasco River and about 6 miles above McMillan dam at Lakewood, N. Mex. The gage was washed out September 6, 1905, and the station was relocated September 7, 1905, about one-half mile upstream.

The channel is straight for 200 feet above and 500 feet below the station. The right bank is high and the cable will be accessible until the river rises above 10 feet on the gage. The left bank is about the same height. The bed is clean shifting sand and the current good.

Discharge measurements were made by means of a cable at the original location until the new gage was established, when the cable was reerected about 100 yards below the new gage.

The present gage is a staff fastened to posts driven into the right bank. During 1905 the gage was read once each day by Eugene Lattion. The bench mark is a nail in the upstream side of the post under the cable on the right bank; elevation, 13.90 feet above the datum of the gage..

*Discharge measurements of Pecos River near Dayton, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | J. M. Giles | 145 | 327 | 1.71 | 2.52 | 559 |
| May 8 | E. Patterson | 188 | 516 | 3.04 | 4.60 | 1,572 |
| May 15 | J. M. Giles | 149 | 409 | 2.80 | 4.18 | 1,145 |
| May 28 | E. Patterson | 192 | 510 | 3.83 | 5.20 | 1,956 |
| June 13 | do | 193 | 644 | 3.60 | 5.30 | 2,319 |
| July 1 | J. M. Giles | 109 | 145 | 1.33 | 2.60 | 193 |
| July 1 | do | 109 | 145 | 1.29 | 2.60 | 187 |
| July 11 | E. Patterson | 72 | 96 | 1.05 | 1.95 | 101 |
| July 15 | do | 71 | 84 | 1.07 | 1.90 | 91 |
| July 23 | do | 196 | 744 | 3.25 | 5.60 | 2,422 |
| July 23 | do | 196 | 789 | 3.32 | 5.80 | 2,623 |
| July 23 | do | 196 | 823 | 3.64 | 6.00 | 3,004 |
| September 1[a] | do | 140 | 170 | .80 | 1.50 | 137 |
| September 6[a] | J. M. Giles | 94 | 126 | 1.55 | 1.72 | 196 |
| September 9 | do | 171 | 552 | 1.82 | 3.40 | 1,006 |
| September 9 | do | 170 | 491 | 1.84 | 3.15 | 905 |
| September 12 | do | 96 | 161 | 2.61 | 1.95 | 419 |
| September 12 | do | 96 | 163 | 2.80 | 2.05 | 456 |
| September 15 | E. Patterson | 96 | 108 | 2.14 | 1.50 | 236 |
| October 4 | J. M. Giles | 109 | 142 | 1.62 | 1.65 | 230 |
| October 4 | do | 109 | 143 | 1.68 | 1.67 | 240 |
| October 15 | E. Patterson | 112 | 142 | 1.60 | 1.70 | 228 |
| October 21 | do | 111 | 139 | 1.46 | 1.67 | 204 |
| November 7 | do | | 204 | 1.71 | 2.26 | 359 |
| November 23 | J. M. Giles | | 241 | 1.76 | 2.40 | 425 |
| November 23 | do | | 238 | 1.79 | 2.40 | 427 |
| November 26 | do | | 759 | 2.20 | 4.30 | 1,668 |
| November 28[b] | do | | 380 | 1.55 | 3.00 | 588 |
| November 28[b] | do | | 378 | 1.62 | 3.05 | 612 |
| December 8 | E. Patterson | | 280 | 2.08 | 2.60 | 583 |
| December 28 | do | | 202 | 1.63 | 2.30 | 329 |

[a] Measurement by wading.

[b] Backwater from McMillan reservoir.

NOTE.—Measurements April 18 to September 1 made below the mouth of the Penasco; after September 1 made above mouth of Penasco.

*Daily gage height, in feet, of Pecos River near Dayton, N. Mex., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.85 | 5.1 | 4.6 | 2.5 | 3.4 | 1.5 | 1.4 | 1.6 | 3.5 |
| 2 | ........ | 1.85 | 4.95 | 4.5 | 2.5 | 3.8 | 1.7 | 1.5 | 1.9 | 3.5 |
| 3 | ........ | 2.5 | 4.9 | 4.3 | 2.4 | 3.9 | 2.2 | 1.6 | 1.5 | 3.5 |
| 4 | ........ | 2.1 | 4.9 | 4.5 | 2.3 | 4.0 | 2.5 | 1.7 | 2.0 | 3.4 |
| 5 | ........ | 2.65 | 5.1 | 4.2 | 2.3 | 3.6 | 2.3 | 1.7 | 2.2 | 3.4 |
| 6 | ........ | 2.3 | 5.2 | 4.3 | 2.2 | 3.6 | 1.7 | 1.7 | 2.2 | 3.0 |
| 7 | ........ | 2.3 | 5.2 | 5.6 | 2.1 | 3.4 | 4.5 | 1.7 | 2.2 | 2.9 |
| 8 | ........ | 2.25 | 5.0 | 4.5 | 2.1 | 5.0 | 3.4 | 1.7 | 2.3 | 2.9 |
| 9 | ........ | 2.25 | 5.4 | 4.4 | 2.2 | 4.8 | 3.3 | 1.6 | 2.4 | 2.7 |
| 10 | ........ | 2.15 | 4.9 | 4.4 | 2.1 | 4.5 | 2.8 | 1.6 | 3.0 | 2.7 |
| 11 | ........ | 2.15 | 4.7 | 4.6 | 2.1 | 3.8 | 2.5 | 1.6 | 2.9 | 2.7 |
| 12 | ........ | 2.1 | 4.3 | 6.0 | 2.0 | 3.5 | 2.0 | 1.7 | 2.9 | 2.7 |
| 13 | ........ | 3.0 | 4.3 | 5.4 | 2.0 | 3.3 | 2.2 | 1.8 | 2.7 | 2.7 |
| 14 | ........ | 3.3 | 4.4 | 4.6 | 2.0 | 3.4 | 2.0 | 1.5 | 2.6 | 3.1 |
| 15 | ........ | 3.0 | 4.2 | 4.7 | 2.0 | 4.0 | 1.5 | 1.7 | 2.5 | 3.0 |
| 16 | ........ | 3.5 | 4.0 | 4.5 | 2.0 | 3.9 | 1.7 | 1.7 | 2.5 | 3.0 |
| 17 | ........ | 3.55 | 4.2 | 4.6 | 1.9 | 3.0 | 1.8 | 1.7 | 2.6 | 2.9 |
| 18 | ........ | 3.3 | 4.2 | 4.3 | 1.8 | 2.8 | 1.5 | 1.7 | 2.9 | 2.9 |
| 19 | ........ | 3.5 | 4.0 | 4.2 | 1.8 | 2.9 | 1.3 | 1.7 | 2.3 | 2.9 |
| 20 | ........ | 3.3 | 4.2 | 4.0 | 3.8 | 2.5 | 3.0 | 1.7 | 2.3 | 2.7 |
| 21 | ........ | 3.25 | 6.5 | 3.7 | 3.0 | 2.3 | 2.0 | 1.7 | 2.3 | 2.7 |
| 22 | ........ | 3.3 | 4.9 | 3.7 | 2.8 | 2.0 | 1.5 | 1.7 | 2.5 | 2.7 |
| 23 | ........ | 4.1 | 5.2 | 3.6 | 10.9 | 2.2 | 1.4 | 1.7 | 2.4 | 2.7 |
| 24 | 2.5 | 5.6 | 4.5 | 3.4 | ........ | 1.8 | 1.5 | 1.7 | 4.5 | 2.8 |
| 25 | 2.3 | 6.45 | 6.2 | 3.9 | ........ | 1.7 | 1.5 | 1.6 | 5.4 | 3.2 |
| 26 | 2.25 | 5.7 | 5.4 | 3.2 | ........ | 1.7 | 1.5 | 1.7 | 4.2 | 2.55 |
| 27 | 1.85 | 5.85 | 5.0 | 3.1 | 5.9 | 1.6 | 1.5 | 1.7 | 3.6 | 2.5 |
| 28 | 1.85 | 5.2 | 5.0 | 3.0 | 5.5 | 1.6 | 1.4 | 1.6 | 3.2 | 2.5 |
| 29 | 2.0 | 4.95 | 5.7 | 3.0 | 4.9 | 1.5 | 1.5 | 1.6 | 2.9 | 2.6 |
| 30 | 2.0 | 4.7 | 4.7 | 2.6 | 4.2 | 1.2 | 1.5 | 1.6 | 3.4 | 2.4 |
| 31 | 1.85 | ........ | 4.7 | ........ | 3.7 | 1.2 | ........ | 1.6 | ........ | 3.0 |

NOTE.—Water above gage July 24-26.

## PECOS RIVER AT CARLSBAD, N. MEX.

This station was established May 20, 1903, by V. L. Sullivan. It is located at the Green Street Bridge, Carlsbad, N. Mex., and is about 500 feet below the station of the Pecos Valley and Northeastern Railway and 2,000 feet below the Hagerman power dam.

Both banks are high and not subject to overflow. The bed of the river is solid rock, much corrugated, which makes low-water measurements subject to considerable inaccuracy. The The channel is straight for some distance above and below the station. The current is swift at the station, but sluggish, both above and below.

Discharge measurements are made by wading when the stage of the river will permit, and from the lower side of the bridge during floods. The initial point for soundings is on the south side of the bridge at the west abutment.

The bridge and original gage were carried away by the flood of October, 1904. The new gage is in three sections: The first is a vertical section, reading from 0 to 6 feet, spiked to the abutment on the right bank. The second section, reading from 6 to 10 feet, is spiked to a post on the right bank. The third section, reading from 9 to 19 feet, is nailed to a pile in the railroad trestle over a ravine about 100 feet south of Green street and 100 feet from the river bank. The datum is the same as that of the original gage. During 1905 the gage was read twice a day by V. L. Sullivan, a civil engineer in the employ of the Pecos Valley Irrigation Company. The bench mark is the northeast corner of the stone threshold at the door of the men's waiting room of the Pecos Valley and Northeastern Railway depot; elevation, 25.63 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, pp 358-359; 132, p 103.
Discharge: 99, p 359; 132, p 103.
Gage heights: 99, pp 359-360; 132, p 104.

*Discharge measurements of Pecos River at Carlsbad, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 24 | F. S. Dobson | 190 | 671 | 2.10 | 2.39 | 1,413 |
| March 13 | V. L. Sullivan | 190 | 1,236 | 2.42 | 4.05 | 3,001 |
| May 8 | Murphy and Giles | 212 | 765 | 3.84 | 4.10 | 2,941 |
| May 9 | do | 202 | 608 | 4.51 | 3.95 | 2,740 |
| May 13 | J. M. Giles | 165 | 169 | 1.98 | 1.25 | 334 |
| July 5 | do | 103 | 113 | 2.30 | 1.13 | 261 |
| July 10 | do | 120 | 185 | 3.66 | 1.76 | 678 |
| July 25[a] | V. L. Sullivan | 310 | 4,110 | 13.36 | 15.85 | 54,930 |
| July 26[a] | do | 290 | 3,151 | 12.29 | 12.60 | 38,730 |
| July 27[a] | do | 260 | 2,266 | 10.76 | 9.85 | 24,380 |
| July 28 | do | 245 | 1,403 | 8.05 | 7.00 | 11,300 |
| August 5 | J. M. Giles | 189 | 870 | 2.39 | 3.43 | 2,082 |
| August 7 | do | 182 | 708 | 2.04 | 2.70 | 1,441 |
| October 10 | do | | 86 | 2.36 | 1.07 | 203 |
| October 11 | do | 78 | 87 | 2.36 | 1.07 | 207 |
| November 27 | do | | 407 | 4.72 | 3.05 | 1,923 |

[a] Made by floats.

*Daily gage height, in feet, of Pecos River at Carlsbad, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.23 | 1.89 | 2.81 | 1.3 | 3.87 | 1.85 | 1.2 | 3.9 | 1.19 | 1.28 | 1.42 | 2.19 |
| 2 | 1.23 | 1.88 | 2.8 | 1.29 | 3.77 | 1.4 | 1.18 | 4.15 | 1.2 | 1.58 | 1.44 | 2.21 |
| 3 | 1.23 | 1.88 | 2.79 | 1.27 | 1.65 | 1.1 | 1.18 | 4.77 | 1.55 | 1.61 | 1.44 | 2.26 |
| 4 | 1.23 | 1.88 | 2.4 | 1.26 | 1.4 | 1.12 | 1.18 | 3.57 | 1.24 | 1.58 | 1.48 | 2.31 |
| 5 | 1.23 | 1.88 | 1.4 | 1.28 | 1.4 | 1.7 | 1.19 | 3.45 | 1.48 | 1.55 | 1.44 | 2.16 |
| 6 | 1.23 | 1.88 | 2.12 | 1.3 | 1.67 | 2.9 | 1.19 | 3.25 | 1.49 | 1.15 | 1.44 | 2.09 |
| 7 | 1.23 | 1.88 | 2.5 | 1.28 | 4.35 | 4.05 | 1.18 | 2.9 | 1.84 | 1.11 | 1.27 | 2.02 |
| 8 | 1.23 | 1.87 | 2.8 | 1.29 | 4.2 | 4.2 | 1.18 | 2.57 | 3.0 | 1.08 | 1.2 | 1.92 |
| 9 | 1.23 | 1.87 | 3.13 | 1.29 | 3.95 | 4.05 | 1.91 | 2.4 | 3.0 | 1.08 | 1.45 | 1.86 |
| 10 | 1.23 | 1.87 | 3.18 | 1.3 | 1.55 | 3.78 | 1.77 | 2.15 | 2.58 | 1.08 | 1.47 | 1.84 |
| 11 | 1.23 | 1.87 | 3.2 | 1.3 | 1.65 | 3.47 | 1.68 | 2.51 | 2.09 | 1.08 | 1.77 | 1.82 |
| 12 | 1.23 | 1.87 | 4.19 | 1.31 | 2.35 | 1.69 | 1.55 | 2.62 | 1.9 | 1.09 | 1.98 | 1.81 |
| 13 | 1.23 | 1.87 | 4.06 | 1.32 | 1.35 | 2.68 | 1.36 | 2.72 | 1.62 | 1.1 | 1.98 | 1.87 |
| 14 | 1.23 | 1.85 | 3.96 | 1.32 | 1.29 | 3.57 | 1.2 | 2.27 | 1.55 | 1.11 | 1.96 | 1.89 |
| 15 | 1.23 | 1.85 | 3.78 | 1.32 | 1.26 | 3.82 | 1.17 | 2.13 | 1.04 | 1.12 | 1.75 | 1.88 |
| 16 | 1.23 | 1.85 | 3.55 | 1.62 | 1.26 | 3.7 | 1.15 | 2.07 | 1.03 | 1.12 | 1.75 | 1.88 |
| 17 | 1.23 | 1.85 | 3.29 | 1.64 | 1.27 | 3.41 | 1.14 | 2.12 | 1.01 | 1.13 | 1.75 | 1.86 |
| 18 | 1.24 | 1.84 | 2.93 | 1.9 | 1.28 | 3.12 | 1.1 | 1.9 | .99 | 1.13 | 1.75 | 1.82 |
| 19 | 1.24 | 1.84 | 2.65 | 1.91 | 1.29 | 2.75 | 1.0 | 1.7 | .99 | 1.13 | 1.74 | 1.8 |
| 20 | 1.24 | 1.83 | 2.35 | 1.96 | 2.05 | 2.35 | .99 | 1.65 | 1.0 | 1.14 | 1.73 | 1.75 |
| 21 | 1.24 | 1.83 | 1.2 | 2.0 | 3.6 | 2.1 | 1.48 | 1.52 | 1.0 | 1.14 | 1.72 | 1.68 |
| 22 | 1.24 | 1.83 | 1.18 | 2.1 | 3.52 | 1.23 | 1.54 | 1.47 | 1.04 | 1.14 | 1.71 | 1.62 |
| 23 | 1.24 | 1.83 | 1.19 | 2.05 | 3.6 | 1.23 | 2.77 | 1.45 | 1.06 | 1.14 | 1.7 | 1.6 |
| 24 | 1.24 | 2.39 | 1.22 | 2.5 | 2.4 | 1.23 | 8.67 | 1.43 | 1.06 | 1.15 | 1.69 | 1.64 |
| 25 | 1.24 | 2.38 | 1.23 | 4.3 | 3.8 | 1.22 | 14.39 | 1.37 | 1.08 | 1.15 | 1.69 | 1.68 |
| 26 | 1.3 | 2.36 | 1.25 | 4.38 | 4.2 | 1.22 | 12.42 | 1.31 | 1.1 | 1.15 | 2.61 | 1.61 |
| 27 | 1.6 | 2.35 | 1.28 | 4.28 | 3.91 | 1.21 | 10.0 | 1.25 | 1.18 | 1.16 | 3.11 | 1.6 |
| 28 | 1.9 | 2.6 | 1.3 | 4.15 | 3.77 | 1.2 | 7.0 | 1.28 | 1.22 | 1.16 | 2.95 | 1.58 |
| 29 | 1.9 | ........ | 1.28 | 4.1 | 3.6 | 1.2 | 5.35 | 1.25 | 1.12 | 1.17 | 2.67 | 1.56 |
| 30 | 1.9 | ........ | 1.28 | 4.02 | 3.6 | 1.2 | 4.5 | 1.22 | 1.12 | 1.17 | 2.45 | 1.55 |
| 31 | 1.89 | ........ | 1.28 | ........ | 3.6 | ........ | 4.15 | 1.2 | ........ | 1.17 | ........ | 1.54 |

*Station rating table*[a] *for Pecos River at Carlsbad, N. Mex., from May 29, 1903, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| .30 | 22 | 2.00 | 870 | 3.70 | 2,470 | 6.80 | 10,520 |
| .40 | 35 | 2.10 | 950 | 3.80 | 2,610 | 7.00 | 11,300 |
| .50 | 50 | 2.20 | 1,030 | 3.90 | 2,750 | 7.20 | 12,080 |
| .60 | 70 | 2.30 | 1,110 | 4.00 | 2,900 | 7.40 | 12,870 |
| .70 | 95 | 2.40 | 1,190 | 4.20 | 3,220 | 7.60 | 13,670 |
| .80 | 125 | 2.50 | 1,275 | 4.40 | 3,570 | 7.80 | 14,500 |
| .90 | 165 | 2.60 | 1,360 | 4.60 | 3,940 | 8.00 | 15,400 |
| 1.00 | 210 | 2.70 | 1,445 | 4.80 | 4,350 | 8.20 | 16,360 |
| 1.10 | 255 | 2.80 | 1,530 | 5.00 | 4,800 | 8.40 | 17,320 |
| 1.20 | 305 | 2.90 | 1,615 | 5.20 | 5,290 | 8.60 | 18,280 |
| 1.30 | 360 | 3.00 | 1,700 | 5.40 | 5,820 | 8.80 | 19,240 |
| 1.40 | 420 | 3.10 | 1,790 | 5.60 | 6,380 | 9.00 | 20,200 |
| 1.50 | 490 | 3.20 | 1,890 | 5.80 | 6,970 | 9.20 | 21,160 |
| 1.60 | 560 | 3.30 | 1,990 | 6.00 | 7,600 | 9.40 | 22,120 |
| 1.70 | 635 | 3.40 | 2,100 | 6.20 | 8,290 | 9.60 | 23,080 |
| 1.80 | 710 | 3.50 | 2,220 | 6.40 | 9,020 | 9.80 | 24,040 |
| 1.90 | 790 | 3.60 | 2,340 | 6.60 | 9,760 | 10.00 | 25,000 |

[a] The above table is not strictly applicable June 13 to 22, 1903, owing to a considerable change in the high-water section during the flood of October, 1904.

The above table is based on two discharge measurements made during 1903, three made during 1904, and 16 made during 1905. It is fairly well defined between gage heights 1 foot and 16 feet. Below 1 foot it is subject to error as high as 20 per cent.

*Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1903.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| June[a] | 15,640 | 119 | 1,959 | 116,600 |
| July | 390 | 110 | 164 | 10,080 |
| August | 110 | 82 | 92.7 | 5,700 |
| September | 85 | 82 | 82.8 | 4,927 |
| October | 82 | 80 | 81.5 | 5,011 |
| November | 82 | 80 | 81.7 | 4,862 |
| December | 82 | 80 | 80.3 | 4,938 |
| The period | | | | 152,100 |

[a] See rating table footnote.

*Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 161 | 80 | 99.4 | 6,112 |
| February | 141 | 90 | 94.0 | 5,407 |
| March | 137 | 22 | 85.0 | 5,226 |
| April | 90 | 88 | 88.1 | 5,242 |
| May | 110 | 0 | 84.3 | 5,183 |
| June | 122 | 75 | 91.4 | 5,439 |
| July | 107 | 95 | 96.5 | 5,934 |
| August | 420 | 104 | 132 | 8,116 |
| September | 224 | 107 | 152 | 9,045 |
| October 1-2; 11-31 | 30,200 | 1,190 | 4,269 | 194,800 |
| November | 1,530 | 255 | 695 | 41,300 |
| December 1-24 | 766 | 295 | 521 | 24,800 |
| The period | | | | 316,700 |

*Estimated monthly discharge of Pecos River at Carlsbad, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 790 | 322 | 392 | 24,100 |
| February | 1,360 | 734 | 838 | 46,540 |
| March | 3,204 | 295 | 1,266 | 77,840 |
| April | 3,534 | 338 | 1,079 | 64,210 |
| May | 3,480 | 338 | 1,574 | 96,780 |
| June | 3,220 | 255 | 1,256 | 74,740 |
| July | 47,600 | 206 | 5,236 | 321,900 |
| August | 4,287 | 305 | 1,164 | 71,570 |
| September | 1,700 | 206 | 486 | 28,920 |
| October | 568 | 246 | 308 | 18,940 |
| November | 1,800 | 305 | 739 | 43,970 |
| December | 1,118 | 518 | 742 | 45,620 |
| The year | 47,600 | 206 | 1,257 | 915,100 |

### PECOS RIVER AND MARGUERETTA FLUME NEAR PECOS, TEX.

This station was established January 1, 1898, by Thomas U. Taylor, and is located about 6 miles above Pecos, Tex., at the flume of the Barstow Irrigation Company (old Margueretta Canal Company). The canal diverts the water from Pecos River 3 miles above the flume from the west side of the river. The water, except about 10 second-feet taken by the West Valley ditch, is carried across to the east side by a timber flume supported on pile bents.

The channel is straight for 300 feet above and 100 feet below the measuring section. The river bed is sandy and shifting. In floods such as those of October, 1904, and July, 1905, a large volume of water passes down the West Valley, west of the canal. This water spreads over the country from the flume to Pecos and can not be measured with any accuracy.

Discharge measurements are made from a cable about 200 yards below the flume. The initial point for soundings is the post supporting the cable on the west bank. Measurements taken in the flume at the east end show the amount of water used for irrigation on the east side of the river.

The gage is a staff which is nailed to one of the piles under the upstream side of the flume. The gage in the flume is at the east end and has its zero at the bottom of the flume. During 1905 both gages were read by Lawrence Vauter, gate keeper for the irrigation company. Bench marks were established as follows: (1) The top of the west abutment on the north side of the flume, marked "U. S. G. S. B. M. 21.70;" elevation, 21.70 feet. (2) On the stone wall on the south side of the canal, under the window of the gate keeper's house, marked "U. S. G. S. B. M. 20.95;" elevation, 20.95 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

*Pecos River near Pecos, Tex.*

Description: WS 28, p 119; 37, p 285; 50, p 358; 66, p 76; 84, pp 168–169; 99, p 355; 132, pp 104–105.
Discharge: WS 28, p 130; 37, p 385; 50, p 359; 66, p 77; 84, p 169; 99, p 356; 132, p 105.
Discharge, monthly: WS 84, p 172; 99, p 358; 132, p 109.
Discharge, yearly: Ann 20, iv, p 57.
Gage heights: WS 28, p 125; 37, p 286; 50, pp 360–361; 66, p 77; 84, p 170; 99, p 356; 132, p 106.
Rating tables: WS 84, p 171; 99, p 357; 132, p 108.

*Margueretta flume near Pecos, Tex.*

Description: WS 84, pp 168–169; 99, p 355; 132, pp 104–105.
Discharge: WS 50, p 360; 66, p 77; 84, p 169; 132, p 105.
Gage heights: WS 50, p 361; 84, p 171; 99, p 357; 132, p 107.
Rating table: WS 132, p 108.

*Discharge measurements of Pecos River near Pecos, Tex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 10 | Murphy and Giles | 144 | 695 | 3.55 | 6.10 | 2,470 |
| July 11 | J. M. Giles | 81 | 105 | 1.81 | 1.27 | 189 |
| July 11 | do | 81 | 103 | 1.72 | 1.25 | 177 |
| July 14 | E. Patterson | 99 | 150 | 2.50 | 2.20 | 376 |
| August 11 | J. M. Giles | 172 | 496 | 2.66 | 3.25 | 1,318 |
| August 12 | do | 170 | 463 | 2.82 | 3.20 | 1,304 |
| August 31 | E. Patterson | 96 | 205 | 2.10 | 1.20 | 432 |
| September 13 | do | 90 | 359 | 2.49 | 2.50 | 895 |
| September 14 | do | 89 | 326 | 2.39 | 2.20 | 779 |
| October 6 | J. M. Giles | 138 | 254 | 1.81 | 1.40 | 459 |
| October 7 | do | 138 | 263 | 1.95 | 1.50 | 513 |
| October 16 | E. Patterson | 82 | 92 | 1.45 | 0.20 | 134 |
| October 20 | do | 80 | 88 | 1.30 | 0.10 | 115 |
| November 8 | do | | 184 | 1.87 | 1.00 | 334 |
| November 16 | Grover and Giles | | 413 | 2.12 | 2.22 | 873 |
| November 17 | J. M. Giles | | 398 | 2.24 | 2.20 | 884 |
| December 6 | E. Patterson | 169 | 444 | 2.37 | 2.80 | 1,055 |
| (a) | J. M. Giles | | 1,304 | 4.92 | 8.00 | 6,416 |
| (a) | do | | 2,024 | 6.32 | 12.00 | 12,790 |
| (a) | do | | 3,140 | 7.91 | 18.00 | 24,840 |

[a] Computed from slope measurement, using Kutter's formula.

*Daily gage height, in feet, of Pecos River, near Pecos, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 2.5 | 4.3 | 2.1 | 5.0 | 5.5 | 2.5 | 7.6 | 1.4 | ....... | 0.2 | 2.8 |
| 2 | 2.0 | 2.5 | 4.3 | 2.0 | 4.3 | 5.0 | 1.5 | 6.2 | ....... | ....... | .2 | 2.6 |
| 3 | 2.1 | 2.5 | 4.3 | 1.9 | 3.0 | 3.9 | 1.5 | 5.65 | ....... | ....... | .2 | 2.4 |
| 4 | 2.1 | 2.5 | 4.3 | 1.9 | 3.0 | 2.9 | 1.5 | 6.15 | ....... | ....... | .4 | 2.3 |
| 5 | 2.1 | 2.5 | 4.1 | 1.9 | 3.0 | 2.0 | 1.5 | 5.85 | ....... | ....... | .9 | 2.0 |
| 6 | 2.1 | 2.5 | 4.1 | 1.9 | 2.8 | 1.9 | 1.5 | 4.9 | ....... | 1.4 | .9 | 1.9 |
| 7 | 2.1 | 2.9 | 4.1 | 1.6 | 2.6 | 3.1 | 1.4 | 4.5 | ....... | 1.5 | 1.0 | 2.0 |
| 8 | 2.1 | 3.0 | 4.1 | 1.6 | 2.6 | 4.0 | 1.4 | 4.0 | ....... | 1.4 | 1.1 | 2.3 |
| 9 | 2.1 | 3.1 | 4.1 | 1.5 | 6.0 | 6.0 | 1.4 | 3.7 | 1.4 | .9 | 1.0 | 2.4 |
| 10 | 2.1 | 3.2 | 4.1 | 1.4 | 6.1 | 6.2 | 1.2 | 3.6 | 4.5 | .3 | 1.0 | 2.4 |
| 11 | 2.1 | 3.2 | 4.6 | 1.4 | 6.0 | 6.0 | 2.5 | 3.5 | 3.5 | .3 | 1.0 | 2.4 |
| 12 | 2.1 | 3.1 | 4.6 | 1.4 | 3.0 | 5.8 | 2.3 | 3.2 | 3.2 | .2 | 1.1 | 2.4 |
| 13 | 2.1 | 3.1 | 5.9 | 1.3 | 2.6 | 5.9 | 2.2 | 3.4 | 2.6 | .2 | 1.4 | 2.1 |
| 14 | 2.1 | 3.1 | 6.6 | 1.1 | 3.6 | 4.9 | 1.9 | 3.6 | 2.2 | .2 | 2.4 | 2.0 |
| 15 | 2.1 | 3.1 | 6.6 | 1.1 | 3.2 | 3.2 | 1.5 | 3.5 | 2.1 | .2 | 2.3 | 2.0 |
| 16 | 2.1 | 3.1 | 6.5 | 1.1 | 2.5 | 5.0 | 1.4 | 3.0 | 2.1 | .2 | 2.2 | 2.0 |
| 17 | 2.1 | 3.1 | 6.2 | 1.1 | 2.0 | 5.9 | 1.4 | 3.0 | ....... | .2 | 2.2 | 2.0 |
| 18 | 2.1 | 3.1 | 6.1 | 1.6 | 1.9 | 6.0 | 1.0 | 2.9 | ....... | .2 | 1.8 | 2.1 |
| 19 | 2.1 | 3.1 | 6.0 | 1.7 | 1.5 | 5.6 | .9 | 2.9 | ....... | .2 | 1.8 | 2.1 |
| 20 | 2.1 | 3.0 | 5.0 | 1.8 | 1.0 | 4.9 | .9 | 2.8 | ....... | .1 | 1.8 | 2.0 |
| 21 | 2.1 | 3.0 | 5.1 | 2.0 | 1.0 | 4.0 | .9 | 2.8 | ....... | .1 | 1.8 | 2.0 |
| 22 | 2.0 | 3.0 | 5.1 | 2.1 | 2.0 | 3.8 | .9 | 2.8 | ....... | .1 | 1.8 | 1.9 |
| 23 | 2.0 | 3.0 | 4.2 | 2.1 | 4.9 | 2.9 | 1.0 | 2.6 | ....... | .2 | 1.8 | 1.8 |
| 24 | 2.0 | 3.0 | 3.9 | 3.0 | 5.0 | 2.8 | 4.9 | 2.0 | ....... | .3 | 1.7 | 1.8 |
| 25 | 2.0 | 3.0 | 2.1 | 3.1 | 5.1 | 1.8 | 7.2 | 1.6 | ....... | .3 | 1.6 | 1.8 |
| 26 | 2.0 | 4.2 | 2.1 | 4.0 | 4.0 | 1.6 | 9.4 | 1.2 | ....... | .3 | 1.6 | 1.8 |
| 27 | 2.0 | 4.5 | 2.1 | 5.5 | 5.6 | 1.5 | 13.7 | 1.2 | ....... | .3 | 1.6 | 1.8 |
| 28 | 2.0 | 4.4 | 2.1 | 6.5 | 6.0 | 1.5 | 18.3 | 1.2 | ....... | .2 | 3.1 | 1.8 |
| 29 | 2.0 | ....... | 2.1 | 6.6 | 5.6 | 1.5 | 17.2 | 1.2 | ....... | .2 | 3.5 | 1.8 |
| 30 | 2.0 | ....... | 2.1 | 6.0 | 5.5 | 4.5 | 13.2 | 1.2 | ....... | .2 | 3.4 | 1.7 |
| 31 | 2.0 | ....... | 2.0 | ....... | 5.5 | ....... | 10.2 | 1.2 | ....... | .2 | ....... | 1.7 |

*Station rating table for Pecos River, near Pecos, Tex., from January 1 to July 24, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 140 | 2.20 | 375 | 3.50 | 835 | 4.80 | 1,535 |
| 1.00 | 150 | 2.30 | 400 | 3.60 | 880 | 4.90 | 1,600 |
| 1.10 | 160 | 2.40 | 430 | 3.70 | 925 | 5.00 | 1,665 |
| 1.20 | 170 | 2.50 | 460 | 3.80 | 975 | 5.20 | 1,795 |
| 1.30 | 185 | 2.60 | 490 | 3.90 | 1,025 | 5.40 | 1,935 |
| 1.40 | 200 | 2.70 | 525 | 4.00 | 1,080 | 5.60 | 2,075 |
| 1.50 | 220 | 2.80 | 560 | 4.10 | 1,135 | 5.80 | 2,220 |
| 1.60 | 240 | 2.90 | 595 | 4.20 | 1,190 | 6.00 | 2,370 |
| 1.70 | 260 | 3.00 | 630 | 4.30 | 1,245 | 6.20 | 2,530 |
| 1.80 | 280 | 3.10 | 670 | 4.40 | 1,300 | 6.40 | 2,690 |
| 1.90 | 300 | 3.20 | 710 | 4.50 | 1,355 | 6.60 | 2,850 |
| 2.00 | 325 | 3.30 | 750 | 4.60 | 1,415 | | |
| 2.10 | 350 | 3.40 | 790 | 4.70 | 1,475 | | |

The above table is based on four discharge measurements made during 1905. It is no twell defined.

*Station rating table for Pecos River, near Pecos, Tex., from July 25 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.10 | 115 | 1.30 | 465 | 2.50 | 955 | 3.70 | 1,640 |
| .20 | 135 | 1.40 | 500 | 2.60 | 1,000 | 3.80 | 1,715 |
| .30 | 155 | 1.50 | 535 | 2.70 | 1,050 | 3.90 | 1,790 |
| .40 | 180 | 1.60 | 570 | 2.80 | 1,100 | 4.00 | 1,865 |
| .50 | 205 | 1.70 | 610 | 2.90 | 1,150 | 4.20 | 2,030 |
| .60 | 235 | 1.80 | 650 | 3.00 | 1,200 | 4.40 | 2,210 |
| .70 | 265 | 1.90 | 690 | 3.10 | 1,250 | 4.60 | 2,390 |
| .80 | 295 | 2.00 | 730 | 3.20 | 1,305 | 4.80 | 2,580 |
| .90 | 325 | 2.10 | 775 | 3.30 | 1,365 | 5.00 | 2,780 |
| 1.00 | 360 | 2.20 | 820 | 3.40 | 1,430 | | |
| 1.10 | 395 | 2.30 | 865 | 3.50 | 1,500 | | |
| 1.20 | 430 | 2.40 | 910 | 3.60 | 1,570 | | |

The above table is based on 13 discharge measurements made during 1905. It is well defined between gage heights 0.1 foot and 3.2 feet. Above gage height 3.2 feet it is based on three slope measurements.

*Estimated monthly discharge of Pecos River, near Pecos, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 350 | 325 | 340 | 20,910 |
| February | 1,355 | 465 | 682 | 37,880 |
| March | 2,850 | 325 | 1,372 | 84,360 |
| April | 2,850 | 160 | 596 | 35,460 |
| May | 2,470 | 150 | 1,091 | 67,080 |
| June | 2,530 | 220 | 1,243 | 73,960 |
| July | 25,500 | 140 | 3,548 | 218,200 |
| August | 5,800 | 430 | 1,664 | 102,300 |
| September[a] | ........ | ........ | ........ | ........ |
| October 6-31 | 530 | 115 | 189 | 9,747 |
| November | 1,500 | 130 | 592 | 35,230 |
| December | 1,100 | 615 | 764 | 46,980 |
| The period | ........ | ........ | ........ | 732,100 |

[a] No estimate.

**Note.**—For discharge of flume of Barstow Irrigation Company see following pages.

*Discharge measurements of flume of Barstow Irrigation Company near Pecos, Tex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 10 | Murphy and Giles | 20.5 | 33 | 7.83 | 1.70 | 257 |
| July 11 | J. M. Giles | 20.5 | 17.4 | 5.86 | 1.10 | 102 |
| July 11 | do | 20.5 | 17.4 | 5.91 | 1.10 | 103 |
| July 14 | E. Patterson | 20.5 | 18.5 | 6.21 | 1.15 | 115 |
| September 14 | do | 20.5 | 26.6 | 7.07 | 1.40 | 188 |
| October 6 | J. M. Giles | 20.5 | 29 | 7.62 | 1.60 | 219 |
| October 7 | do | 20.5 | 27 | 7.57 | 1.50 | 202 |
| October 16 | E. Patterson | 20.5 | 24 | 7.11 | 1.30 | 168 |
| October 20 | do | 20.5 | 23 | 7.01 | 1.25 | 158 |
| November 8 | do | 20.5 | 27 | 7.30 | 1.40 | 194 |
| November 8 [a] | do | 20.5 | 35 | 4.25 | 1.70 | 148 |
| November 16 | J. M. Giles | 20.5 | 26.6 | 4.97 | 1.30 | 132 |
| November 16 [a] | do | 20.5 | 14 | 2.29 | .80 | 32 |
| December 6 | E. Patterson | 20.5 | 13.3 | 1.57 | .65 | 21 |

[a] At lower end of flume.

*Daily gage height, in feet, of flume of Barstow Irrigation Company near Pecos, Tex., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.0 | 1.8 | 1.8 | 1.6 | | | | 1.3 | 0.8 |
| 2 | | 1.0 | 1.8 | 1.8 | 1.0 | | | | 1.3 | .8 |
| 3 | | 1.0 | 1.8 | 1.6 | 1.0 | | | | 1.3 | .8 |
| 4 | | 1.0 | 1.8 | 1.6 | 1.0 | | | | 1.3 | .8 |
| 5 | | 1.0 | 1.8 | 1.8 | 1.0 | | | | 1.5 | .8 |
| 6 | | 1.0 | 1.8 | 1.8 | 1.0 | | | 1.6 | 1.5 | .8 |
| 7 | | .9 | 1.8 | 1.9 | 1.0 | | | 1.5 | 1.5 | .7 |
| 8 | | 1.0 | 1.8 | 1.9 | 1.0 | | | 1.4 | 1.5 | .7 |
| 9 | | 1.1 | 1.8 | 1.9 | 1.0 | | | 1.4 | 1.5 | .7 |
| 10 | | 1.3 | 1.8 | 1.9 | 1.1 | | 1.5 | 1.4 | 1.5 | .7 |
| 11 | | 1.4 | 1.8 | 1.9 | 1.3 | | 1.5 | 1.3 | 1.5 | .7 |
| 12 | 1.1 | 1.6 | 1.9 | 1.9 | 1.3 | | 1.5 | 1.3 | 1.5 | .7 |
| 13 | 1.1 | 1.8 | 1.9 | 1.6 | 1.05 | | 1.5 | 1.3 | 1.5 | .7 |
| 14 | 1.1 | 1.8 | 1.8 | 1.6 | 1.5 | | 1.4 | 1.3 | 1.5 | .6 |
| 15 | 1.1 | 1.8 | 1.8 | 1.6 | 1.6 | | 1.4 | 1.3 | 1.3 | .6 |
| 16 | 1.1 | 1.9 | 1.8 | 1.6 | 1.6 | | 1.4 | 1.3 | 1.3 | .6 |
| 17 | 1.1 | 1.9 | 1.8 | 1.6 | 1.6 | | | 1.3 | .8 | .6 |
| 18 | 1.1 | 1.8 | 1.8 | 1.6 | 1.6 | | | 1.3 | .8 | .6 |
| 19 | 1.1 | 1.8 | 1.8 | 1.6 | 1.4 | | | 1.3 | .8 | .6 |
| 20 | 1.2 | 1.8 | 1.8 | 1.8 | 1.3 | | | 1.3 | .8 | .6 |
| 21 | 1.3 | 1.8 | 1.8 | 1.8 | 1.3 | | | 1.3 | .8 | .6 |
| 22 | 1.3 | 1.8 | 1.9 | 1.7 | 1.3 | | | 1.3 | .8 | .6 |
| 23 | 1.3 | 1.8 | 1.8 | 1.7 | 1.5 | | | 1.3 | .8 | .6 |
| 24 | 1.3 | 1.8 | 1.8 | 1.7 | 1.6 | | | 1.3 | .8 | .6 |
| 25 | 1.3 | 1.8 | 1.8 | 1.7 | 1.8 | | | 1.4 | .8 | .6 |
| 26 | 1.3 | 1.8 | 1.8 | 1.7 | 1.6 | | | 1.3 | .8 | .6 |
| 27 | 1.3 | 1.8 | 1.9 | 1.7 | 2.4 | | | 1.3 | .8 | .6 |
| 28 | 1.3 | 1.8 | 1.8 | 1.7 | 2.65 | | | 1.3 | .8 | .6 |
| 29 | 1.3 | 1.8 | 1.8 | 1.7 | 2.35 | | | 1.3 | .8 | .6 |
| 30 | 1.3 | 1.8 | 1.8 | 2.0 | 1.25 | | | 1.3 | .8 | .6 |
| 31 | 1.3 | | 1.8 | | .6 | | | 1.3 | | .6 |

**Note.**—November 1-16 water was being wasted from flume into river; hence gage heights at upper end of flume did not represent flow accurately.

*Station rating table for flume of the Barstow Irrigation Company near Pecos, Tex., from March 12 to November 16, 1905.*[a]

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 10 | 1.00 | 80 | 1.40 | 179 | 1.80 | 285 |
| 0.70 | 22 | 1.10 | 103 | 1.50 | 205 | 1.90 | 312 |
| 0.80 | 38 | 1.20 | 128 | 1.60 | 231 | 2.00 | 340 |
| 0.90 | 57 | 1.30 | 153 | 1.70 | 258 | | |

[a] Not strictly applicable November 1-16, during which time water was being wasted from flume into river; hence gage heights at upper end of flume did not represent flow accurately.

The above table is based on 13 discharge measurements made during 1905. It is fairly well defined between gage heights 1.1 feet and 1.7 feet.

*Estimated monthly discharge of flume of Barstow Irrigation Company near Pecos, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 12-31 | 153 | 103 | 132 | 5,237 |
| April | 312 | 57 | 216 | 12,850 |
| May | 312 | 285 | 288 | 17,710 |
| June | 340 | 231 | 269 | 16,010 |
| July | 522 | 10 | 182 | 11,190 |
| September 10-16 | 205 | 179 | 194 | 2,694 |
| October 6-31 | 231 | 153 | 162 | 8,355 |
| The period | | | | 74,050 |

## PECOS RIVER NEAR MOORHEAD, TEX.

This station was established by the International (Water) Boundary Commission in April, 1900. It is near Moorhead, immediately above the high bridge of the Southern Pacific Railroad.

The station is in the bottom of a canyon about 300 feet deep. The river is straight for a mile or more both above and below the station. Both banks are of rock, but the bottom of the stream is mud. The river here consists of a series of pools connected by rapids. The best pool was chosen for the station.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the cable support on the left bank.

The gage is a scantling bolted to one of the piers of the bridge. Its painted face is read from the top of the cliff with the aid of field glasses. The highest known flood occurred April 6, 1900, about two weeks before this gage was established. The water marks showed that it reached 35.75 feet on the gage. The range between high and low water is 35 feet. The bench mark is a cross cut on solid rock above a spring about 600 feet above the bridge; elevation, 27.08 above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter and the gage reader is the section foreman for the railroad.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 50, p 362; 66, p 77; 84, p 166; 99, p 351; 132, p 109.
**Discharge**: 50, p 363; 66, p 78; 84, pp 166–167; 99, pp 352–353; 132, pp 109–111.
**Discharge, mean daily**: 132, p 113.
**Discharge, monthly**: 75, p 160; 84, p 168; 99, p 354; 132, p 114.
**Gage heights**: 50, p 363; 66, p 78; 84, p 167; 99, p 354; 132, p 112.

*Discharge measurements of Pecos River near Moorhead, Tex., in 1905.*

| Date. | Hpdrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 3 | E. E. Winter | 773 | 0.98 | 1.75 | 758 |
| January 7 | do | 774 | .95 | 1.75 | 735 |
| January 12 | do | 762 | .80 | 1.65 | 611 |
| January 16 | do | 756 | .80 | 1.6 | 604 |
| January 20 | do | 755 | .74 | 1.5 | 557 |
| January 24 | do | 724 | .73 | 1.5 | 531 |
| January 29 | do | 726 | .73 | 1.5 | 532 |
| February 3 | do | 762 | .91 | 1.7 | 694 |
| February 7 | do | 760 | .93 | 1.75 | 710 |
| February 11 | do | 775 | 1.02 | 2.0 | 787 |
| February 15 | do | 790 | 1.03 | 2.0 | 811 |
| February 20 | do | 807 | 1.07 | 2.2 | 861 |
| February 23 | do | 782 | 1.01 | 2.1 | 791 |
| February 26 | do | 795 | 1.01 | 2.05 | 806 |
| March 8 | do | 924 | 1.97 | 3.4 | 1,817 |
| March 11 | do | 849 | 1.39 | 2.7 | 1,180 |
| March 16 | do | 893 | 1.72 | 3.2 | 1,532 |
| March 20 | do | 1,004 | 2.20 | 3.7 | 2,212 |
| March 24 | do | 824 | 1.26 | 2.4 | 1,041 |
| March 29 | do | 770 | 1.03 | 2.1 | 795 |
| April 4 | do | 861 | 1.18 | 2.5 | 1,018 |
| April 8 | do | 821 | .98 | 2.0 | 805 |
| April 12 | do | 827 | .93 | 1.9 | 772 |
| April 17 | do | 790 | .90 | 1.7 | 709 |
| April 21 | do | 785 | .89 | 1.6 | 702 |
| April 25 | do | 921 | 1.47 | 3.0 | 1,356 |
| April 28 | do | 845 | 1.01 | 2.2 | 854 |
| May 3 | do | 1,023 | 2.24 | 3.5 | 2,288 |
| May 8 | do | 1,000 | 2.16 | 3.4 | 2,155 |
| May 11 | do | 981 | 1.62 | 3.1 | 1,594 |
| May 16 | do | 1,010 | 2.02 | 3.4 | 2,040 |
| May 20 | do | 883 | 1.12 | 2.2 | 991 |
| May 24 | do | 950 | 1.72 | 2.8 | 1,633 |
| May 29 | do | 883 | 1.13 | 2.2 | 999 |
| June 3 | do | 1,011 | 1.61 | 3.2 | 1,623 |
| June 9 | do | 948 | 1.23 | 2.6 | 1,166 |
| June 12 | do | 857 | .84 | 1.9 | 720 |
| June 17 | do | 1,037 | 2.24 | 3.5 | 2,324 |
| June 21 | do | 1,004 | 2.07 | 3.4 | 2,078 |
| June 24 | do | 1,010 | 2.00 | 3.3 | 2,025 |
| July 2 | do | 898 | 1.17 | 2.2 | 1,050 |
| July 7 | do | 1,015 | 1.44 | 3.1 | 1,459 |
| July 13 | do | 907 | 1.04 | 2.1 | 942 |
| July 18 | do | 867 | .85 | 2.0 | 734 |
| July 23 | do | 874 | .85 | 2.0 | 739 |

*Discharge measurements of Pecos River near Moorhead, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 28 | E. E. Winter | 768 | 0.83 | 1.65 | 639 |
| August 6 | do | 1,104 | 3.20 | 4.3 | 3,528 |
| August 10 | do | 1,208 | 3.92 | 5.2 | 4,733 |
| August 15 | do | 956 | 2.57 | 3.35 | 2,459 |
| August 20 | do | 899 | 1.69 | 2.8 | 1,521 |
| August 24 | do | 906 | 1.51 | 2.6 | 1,367 |
| August 30 | do | 894 | 1.33 | 2.4 | 1,186 |
| September 6 | do | 782 | .96 | 1.9 | 753 |
| September 11 | do | 775 | .89 | 1.8 | 689 |
| September 14 | do | 785 | .93 | 2.0 | 728 |
| September 22 | do | 803 | 1.08 | 2.2 | 870 |
| September 25 | do | 774 | .96 | 2.0 | 740 |
| September 28 | do | 791 | .97 | 1.9 | 767 |
| October 3 | do | 774 | .81 | 1.7 | 628 |
| October 7 | do | 793 | .91 | 1.9 | 719 |
| October 10 | do | 803 | .94 | 1.9 | 753 |
| October 15 | do | 780 | .84 | 1.75 | 652 |
| October 20 | do | 774 | .78 | 1.6 | 577 |
| October 24 | do | 729 | .73 | 1.5 | 531 |
| October 29 | do | 724 | .71 | 1.5 | 514 |
| November 3 | do | 704 | .72 | 1.4 | 510 |
| November 7 | do | 707 | .71 | 1.4 | 503 |
| November 10 | do | 711 | .71 | 1.4 | 505 |
| November 14 | do | 743 | .86 | 1.7 | 637 |
| November 18 | do | 716 | .75 | 1.6 | 534 |
| November 22 | do | 792 | 1.12 | 2.2 | 886 |
| November 25 | do | 783 | 1.12 | 2.2 | 875 |
| December 2 | H. F. Collins | 772 | 1.15 | 2.0 | 890 |
| December 8 | do | 827 | 1.53 | 2.4 | 1,267 |
| December 13 | do | 831 | 1.51 | 2.4 | 1,257 |
| December 22 | do | 805 | 1.52 | 2.3 | 1,227 |
| December 25 | do | 788 | 1.44 | 2.3 | 1,138 |
| December 29 | do | 783 | 1.45 | 2.2 | 1,138 |

*Daily gage height, in feet, of Pecos River near Moorhead, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.75 | 1.6 | 2.05 | 6.7 | 2.6 | 3.0 | 2.2 | 3.5 | 2.4 | 1.8 | 1.4 | 2.0 |
| 2 | 1.75 | 1.65 | 2.1 | 3.75 | 2.6 | 3.15 | 2.2 | 3.55 | 2.35 | 1.7 | 1.4 | 2.0 |
| 3 | 1.75 | 1.7 | 2.15 | 3.0 | 3.45 | 3.2 | 2.3 | 3.8 | 2.45 | 1.7 | 1.4 | 2.2 |
| 4 | 1.75 | 1.7 | 2.2 | 2.5 | 3.5 | 3.2 | 2.65 | 3.9 | 2.45 | 1.8 | 1.4 | 2.65 |
| 5 | 1.75 | 1.7 | 2.25 | 2.3 | 3.55 | 3.2 | 2.35 | 4.1 | 2.25 | 1.8 | 1.35 | 2.7 |
| 6 | 1.75 | 1.75 | 2.3 | 2.2 | 3.6 | 3.2 | 2.3 | 4.15 | 1.95 | 1.85 | 1.35 | 2.6 |
| 7 | 1.75 | 1.75 | 2.4 | 2.1 | 3.55 | 3.2 | 3.1 | 4.55 | 1.9 | 1.9 | 1.4 | 2.55 |
| 8 | 1.7 | 1.8 | 3.45 | 2.0 | 3.4 | 3.05 | 4.1 | 4.85 | 1.95 | 1.9 | 1.4 | 2.4 |
| 9 | 1.7 | 1.85 | 2.75 | 2.0 | 3.35 | 2.65 | 4.4 | 4.9 | 1.9 | 2.0 | 1.4 | 2.4 |
| 10 | 1.7 | 1.9 | 2.6 | 2.0 | 3.2 | 2.05 | 3.55 | 5.1 | 1.9 | 1.95 | 1.4 | 2.45 |
| 11 | 1.65 | 2.0 | 2.65 | 2.0 | 3.15 | 2.0 | 2.7 | 5.5 | 2.0 | 1.8 | 1.6 | 2.5 |
| 12 | 1.65 | 2.0 | 2.6 | 1.9 | 3.1 | 1.9 | 2.35 | 5.6 | 1.8 | 1.8 | 1.7 | 2.45 |
| 13 | 1.65 | 2.0 | 2.6 | 1.9 | 3.1 | 1.75 | 2.1 | 5.4 | 1.9 | 1.75 | 1.7 | 2.4 |
| 14 | 1.6 | 2.0 | 2.6 | 1.85 | 3.2 | 1.7 | 2.0 | 4.9 | 2.05 | 1.75 | 1.8 | 2.4 |
| 15 | 1.55 | 2.0 | 5.2 | 1.8 | 3.2 | 2.15 | 2.0 | 3.6 | 2.65 | 1.75 | 1.8 | 2.4 |
| 16 | 1.5 | 2.0 | 3.25 | 1.7 | 3.4 | 3.0 | 2.0 | 3.5 | 2.9 | 1.75 | 1.8 | 2.3 |
| 17 | 1.5 | 2.1 | 3.2 | 1.7 | 3.3 | 3.45 | 2.0 | 3.25 | 2.75 | 1.7 | 1.8 | 2.3 |
| 18 | 1.5 | 2.15 | 3.35 | 1.7 | 3.15 | 3.5 | 2.0 | 3.0 | 2.4 | 1.65 | 1.7 | 2.3 |
| 19 | 1.45 | 2.2 | 3.55 | 1.7 | 2.8 | 3.5 | 2.0 | 2.8 | 2.3 | 1.65 | 2.0 | 2.3 |
| 20 | 1.45 | 2.2 | 3.7 | 1.6 | 2.25 | 3.5 | 2.0 | 2.8 | 2.3 | 1.6 | 2.1 | 2.3 |
| 21 | 1.45 | 2.2 | 3.2 | 1.6 | 2.35 | 3.4 | 2.1 | 2.8 | 2.2 | 1.55 | 2.2 | 2.3 |
| 22 | 1.45 | 2.1 | 2.85 | 1.6 | 2.75 | 3.4 | 2.0 | 2.7 | 2.2 | 1.5 | 2.2 | 2.3 |
| 23 | 1.45 | 2.1 | 2.65 | 8.95 | 2.7 | 3.4 | 1.95 | 2.6 | 2.2 | 1.5 | 2.2 | 2.3 |
| 24 | 1.5 | 2.1 | 2.45 | 3.05 | 2.8 | 3.2 | 1.7 | 2.6 | 2.2 | 1.5 | 2.2 | 2.3 |
| 25 | 1.5 | 2.05 | 2.25 | 2.95 | 2.85 | 3.05 | 1.7 | 2.6 | 2.05 | 1.5 | 2.2 | 2.3 |
| 26 | 1.5 | 2.05 | 2.7 | 2.7 | 2.55 | 2.9 | 1.6 | 2.5 | 2.0 | 1.5 | 2.1 | 2.3 |
| 27 | 1.5 | 2.05 | 2.7 | 2.25 | 2.4 | 2.65 | 1.65 | 2.5 | 2.0 | 1.45 | 2.1 | 2.3 |
| 28 | 1.5 | 2.0 | 2.5 | 2.2 | 2.4 | 2.95 | 1.65 | 2.5 | 1.95 | 1.45 | 2.1 | 2.2 |
| 29 | 1.55 | ....... | 2.25 | 3.2 | 2.25 | 6.05 | 1.75 | 2.45 | 1.95 | 1.5 | 2.1 | 2.2 |
| 30 | 1.55 | ....... | 2.05 | 2.65 | 2.6 | 2.25 | 3.1 | 2.4 | 1.9 | 1.45 | 2.0 | 2.1 |
| 31 | 1.45 | ....... | 2.0 | ....... | 2.9 | ....... | 3.2 | 2.4 | ....... | 1.45 | ....... | 2.1 |

*Daily discharge, in second-feet, of Pecos River near Moorhead, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 700 | 625 | 805 | 8,950 | 1,100 | 1,700 | 1,050 | 2,090 | 1,190 | 700 | 470 | 830 |
| 2 | 730 | 660 | 845 | 2,070 | 1,100 | 1,690 | [a]1,050 | 2,180 | 1,140 | 630 | 490 | [a] 890 |
| 3 | [a] 760 | [a] 695 | 880 | 1,320 | [a]2,220 | [a]1,620 | 1,095 | 2,630 | 1,230 | [a] 630 | [a] 510 | 1,080 |
| 4 | 750 | 695 | 920 | [a]1,020 | 2,290 | 1,620 | 1,250 | 2,810 | 1,230 | 675 | 510 | 1,500 |
| 5 | 745 | 695 | 955 | 935 | 2,360 | 1,620 | 1,115 | 3,170 | 1,060 | 675 | 490 | 1,550 |
| 6 | 740 | 710 | 990 | 890 | 2,430 | 1,620 | 1,095 | [a]3,260 | [a] 800 | 695 | 490 | 1,460 |
| 7 | [a] 735 | [a] 710 | 1,065 | 845 | 2,360 | 1,620 | [a]1,460 | 3,860 | 750 | [a] 720 | [a] 505 | 1,410 |
| 8 | 670 | 725 | [a]1,855 | [a] 805 | [a]2,150 | 1,500 | 2,460 | 4,270 | 780 | 730 | 505 | [a] 1,270 |
| 9 | 670 | 740 | 1,225 | 805 | 2,060 | [a]1,200 | 2,760 | 4,330 | 750 | 805 | 505 | 1,270 |
| 10 | 670 | 755 | 1,090 | 805 | 1,780 | 810 | 1,910 | [a]4,600 | 750 | [a] 785 | [a] 505 | 1,320 |
| 11 | 610 | [a] 785 | [a]1,135 | 805 | [a]1,680 | 780 | 1,250 | 5,330 | [a] 790 | 685 | 590 | 1,360 |
| 12 | [a] 610 | 790 | 1,110 | [a] 770 | 1,590 | [a] 720 | 1,070 | 5,530 | 690 | 685 | 635 | 1,310 |
| 13 | 610 | 795 | 1,110 | 770 | 1,590 | 640 | [a] 940 | 5,260 | 710 | 650 | 635 | [a] 1,260 |
| 14 | 605 | 800 | 1,110 | 755 | 1,740 | 620 | 850 | 4,580 | [a] 760 | 650 | [a] 680 | 1,260 |
| 15 | 580 | [a] 810 | 5,220 | 740 | 1,740 | 890 | 820 | [a]2,810 | 1,320 | [a] 650 | 660 | 1,260 |
| 16 | [a] 560 | 810 | [a]1,560 | 710 | [a]2,040 | 1,740 | 790 | 2,710 | 1,570 | 650 | 645 | 1,230 |
| 17 | 560 | 835 | 1,530 | [a] 710 | 1,950 | [a]2,260 | 760 | 2,290 | 1,420 | 625 | 630 | 1,230 |
| 18 | 560 | 850 | 1,735 | 715 | 1,820 | 2,280 | [a] 735 | 1,860 | 1,070 | 600 | [a] 575 | 1,230 |
| 19 | 540 | 860 | 2,005 | 720 | 1,510 | 2,240 | 735 | 1,520 | 970 | 600 | 760 | 1,230 |
| 20 | [a] 530 | [a] 860 | [a]2,210 | 700 | [a]1,040 | 2,210 | 740 | [a]1,520 | 970 | [a] 575 | 820 | 1,230 |
| 21 | 520 | 860 | 1,760 | [a] 700 | 1,150 | [a]2,080 | 800 | 1,520 | 870 | 550 | 880 | 1,230 |
| 22 | 515 | 790 | 1,445 | 700 | 1,580 | 2,080 | 740 | 1,440 | [a] 870 | 530 | [a] 885 | [a] 1,230 |
| 23 | 510 | [a] 790 | 1,265 | 14,570 | 1,520 | 2,080 | [a] 725 | 1,370 | 870 | 530 | 880 | 1,200 |
| 24 | [a] 530 | 805 | [a]1,085 | 1,390 | [a]1,630 | [a]1,930 | 650 | [a]1,370 | 870 | [a] 530 | 880 | 1,170 |
| 25 | 530 | 790 | 915 | [a]1,320 | 1,690 | 1,780 | 650 | 1,370 | [a] 770 | 530 | [a] 875 | [a] 1,140 |
| 26 | 530 | [a] 805 | 1,310 | 1,170 | 1,370 | 1,630 | 625 | 1,280 | 770 | 525 | 825 | 1,160 |
| 27 | 530 | 805 | 1,310 | 885 | 1,210 | 1,380 | 640 | 1,280 | 800 | 500 | 825 | 1,180 |
| 28 | 530 | 775 | 1,130 | [a] 855 | 1,210 | [a]1,680 | [a] 640 | 1,280 | [a] 800 | 495 | 825 | 1,120 |
| 29 | [a] 550 | ....... | [a] 915 | 1,480 | [a]1,050 | 7,300 | 670 | 1,230 | 800 | [a] 515 | 825 | [a] 1,140 |
| 30 | 550 | ....... | 755 | 1,140 | 1,420 | 1,040 | 1,460 | [a]1,190 | 765 | 490 | 775 | 1,040 |
| 31 | 510 | ....... | 715 | ....... | 1,740 | ....... | 1,560 | 1,190 | ....... | 490 | ....... | 1,020 |

[a] Meter measurements.

*Estimated monthly discharge of Pecos River, near Moorhead, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 760 | 510 | 605 | 37,170 |
| February | 860 | 625 | 772 | 42,893 |
| March | 5,220 | 715 | 1,354 | 83,226 |
| April | 14,570 | 700 | 1,668 | 99,273 |
| May | 2,430 | 1,040 | 1,681 | 103,379 |
| June | 7,300 | 620 | 1,745 | 103,855 |
| July | 2,760 | 625 | 1,068 | 65,643 |
| August | 5,530 | 1,190 | 2,617 | 160,919 |
| September | 1,570 | 690 | 938 | 55,805 |
| October | 805 | 490 | 616 | 37,884 |
| November | 885 | 470 | 670 | 39,838 |
| December | 1,550 | 830 | 1,220 | 74,995 |
| The year | 14,570 | 470 | 1,246 | 904,880 |

## GALLINAS RIVER NEAR LAS VEGAS, N. MEX.

This station was established August 13, 1903, by E. G. Marsh. It is located at Las Vegas Hot Springs, 6 miles above Las Vegas, N. Mex. The establishment of this station was primarily for the purpose of determining the amount of water available for diversion and storage in the San Guyjuella basin about 6 miles northwest of Las Vegas.

The channel is straight for 50 feet above and 100 feet below the station. The bed is composed of bowlders with a loose deposit of sand and gravel during low water. The right bank is a vertical wall protecting the power house. The left bank is a vertical wall composed of bowlders embedded in binding material. There is but one channel at all stages. The velocity is moderate at low water and very swift during high water.

Discharge measurements are made from a single-span wooden bridge at the power house during high water; at low water discharge measurements are made at the same section by wading.

The original gage was bolted to the masonry wall on the right bank which protects Hot Springs Nos. 16 and 17. These springs are located about 300 feet above the power house and bridge from which discharge measurements are made. The gage was washed out by the flood of September 29, 1904, and was replaced by a similar rod October 19, 1904. The zero of the new rod is 0.71 foot lower than the zero of the old rod. During 1905 the gage was read twice each day by William Prager, except when rapid fluctuations make more frequent observations necessary. The bench mark is a leaded bolt in a granite outcropping on the right (south) bank of the river 200 feet above the gage rod; elevation, 19.17 feet above the datum of the new gage. The 7-foot mark on this gage is identical with the upper surface of the masonry wall to which it is attached.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 253; 132, pp 116-117.
Discharge: 99, p 254; 132, p 117.
Gage heights: 99, p 254; 132, p 118.

*Discharge measurements of Gallinas River near Las Vegas, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 5 [a] | R. I. Meeker | 17 | 20 | 0.45 | 1.80 | 9 |
| April 27 [b] | do | 50 | 78 | 4.19 | 3.10 | 327 |
| May 27 [b] | Meeker and Murphy | 42 | 54 | 3.02 | 2.65 | 163 |
| July 1 [a] | R. I. Meeker | 24 | 23 | 1.04 | 1.90 | 24 |
| August 2 [a] | do | 24 | 25 | 1.20 | 2.00 | 30 |

[a] Made by wading under foot bridge.

[b] Made from Hot Springs bridge.

*Daily gage height, in feet, of Gallinas River near Las Vegas, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.8 | 1.8 | 2.2 | 2.3 | 3.1 | 2.5 | 1.9 | 2.05 | 1.8 | 1.8 | 1.6 | 2.0 |
| 2 | 1.8 | 1.8 | 2.8 | 2.3 | 3.2 | 2.45 | 1.9 | 2.1 | 1.8 | 1.8 | 1.6 | 1.8 |
| 3 | 1.8 | 1.8 | 2.6 | 2.4 | 3.1 | 2.4 | 1.9 | 1.95 | 1.8 | 1.8 | 1.6 | 1.8 |
| 4 | 1.8 | 1.8 | 2.45 | 2.5 | 2.95 | 2.45 | 1.8 | 1.9 | 1.85 | 1.8 | 1.6 | 2.0 |
| 5 | 1.8 | 1.8 | 2.5 | 2.5 | 2.85 | 2.4 | 1.8 | 2.13 | 1.8 | 1.7 | 1.6 | 2.0 |
| 6 | 1.8 | 1.8 | 2.6 | 2.5 | 2.8 | 2.3 | 1.8 | 2.1 | 1.8 | 1.6 | 1.6 | 1.8 |
| 7 | 1.8 | 1.8 | 2.6 | 2.5 | 2.75 | 2.3 | 1.8 | 2.3 | 1.85 | 1.6 | 1.6 | 1.8 |
| 8 | 1.8 | 1.8 | 2.5 | 2.6 | 2.8 | 2.65 | 1.8 | 2.2 | 1.8 | 1.6 | 1.6 | 1.8 |
| 9 | 1.8 | 1.8 | 2.5 | 2.6 | 2.95 | 2.5 | 1.8 | 2.1 | 1.85 | 1.65 | 1.6 | 1.8 |
| 10 | 1.8 | 1.8 | 2.5 | 2.6 | 2.85 | 2.45 | 1.8 | 2.1 | 1.9 | 1.6 | 1.6 | 1.8 |
| 11 | 1.8 | 1.8 | 2.4 | 2.6 | 2.8 | 2.4 | 1.8 | 2.1 | 1.8 | 1.6 | 1.6 | 1.95 |
| 12 | 1.8 | 1.8 | 2.3 | 2.6 | 2.75 | 2.3 | 1.8 | 2.1 | 1.8 | 1.6 | 1.6 | 2.0 |
| 13 | 1.8 | 1.8 | 2.3 | 2.55 | 2.75 | 2.3 | 1.8 | 2.05 | 1.8 | 1.6 | 1.6 | 2.0 |
| 14 | 1.8 | 1.8 | 2.3 | 2.5 | 2.7 | 2.25 | 1.8 | 2.0 | 1.8 | 1.6 | 1.6 | 1.85 |
| 15 | 1.8 | 1.85 | 2.4 | 2.5 | 2.7 | 2.2 | 1.8 | 1.9 | 1.8 | 1.6 | 1.6 | 1.9 |
| 16 | 1.8 | 1.8 | 2.4 | 2.5 | 2.75 | 2.15 | 1.8 | 1.9 | 1.8 | 1.6 | 1.8 | 1.9 |
| 17 | 1.8 | 1.8 | 2.4 | 2.5 | 2.8 | 2.1 | 1.8 | 1.9 | 1.8 | 1.6 | 1.75 | 1.9 |
| 18 | 1.8 | 1.8 | 2.3 | 2.5 | 2.9 | 2.1 | 1.8 | 1.9 | 1.8 | 1.6 | 1.6 | 1.85 |
| 19 | 1.8 | 1.85 | 2.3 | 2.5 | 2.8 | 2.1 | 1.8 | 1.9 | 1.8 | 1.6 | 1.8 | 1.85 |
| 20 | 1.8 | 1.8 | 2.3 | 2.5 | 2.8 | 2.0 | 1.8 | 1.9 | 1.8 | 1.6 | 1.8 | 1.85 |
| 21 | 1.8 | 1.85 | 2.2 | 2.5 | 2.8 | 2.05 | 1.8 | 1.8 | 1.7 | 1.6 | 1.8 | 1.8 |
| 22 | 1.8 | 2.0 | 2.2 | 2.5 | 2.8 | 2.0 | 2.0 | 1.8 | 1.7 | 1.6 | 2.0 | 1.8 |
| 23 | 1.8 | 2.3 | 2.2 | 2.9 | 2.7 | 2.0 | 2.01 | 1.8 | 1.7 | 1.6 | 2.35 | 1.8 |
| 24 | 1.8 | 2.7 | 2.2 | 3.2 | 2.65 | 2.0 | 2.0 | 1.8 | 1.7 | 1.6 | 2.05 | 1.9 |
| 25 | 1.8 | 2.65 | 2.2 | 3.15 | 2.6 | 1.95 | 1.9 | 1.8 | 1.8 | 1.6 | 2.0 | 1.9 |
| 26 | 1.8 | 2.7 | 2.25 | 3.05 | 2.6 | 1.9 | 1.9 | 1.8 | 2.2 | 1.6 | 2.0 | 1.9 |
| 27 | 1.8 | 2.7 | 2.35 | 3.1 | 2.6 | 1.9 | 1.8 | 1.8 | 1.9 | 1.6 | 3.05 | 1.9 |
| 28 | 1.8 | 2.2 | 2.4 | 3.2 | 2.55 | 1.9 | 1.8 | 1.8 | 1.9 | 1.6 | 2.8 | 1.9 |
| 29 | 1.8 | ....... | 2.3 | 3.1 | 2.5 | 1.9 | 1.8 | 1.8 | 1.85 | 1.6 | 2.35 | 1.9 |
| 30 | 1.8 | ....... | 2.25 | 3.0 | 2.5 | 1.9 | 1.8 | 1.8 | 1.8 | 1.6 | 2.2 | 1.9 |
| 31 | 1.8 | ....... | 2.25 | ....... | 2.5 | ....... | 2.3 | 1.8 | ....... | 1.6 | ....... | 1.9 |

*Station rating table for Gallinas River near Las Vegas, N. Mex., from October 8, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 2 | 2.10 | 42 | 2.60 | 148 | 3.10 | 330 |
| 1.70 | 6 | 2.20 | 57 | 2.70 | 178 | 3.20 | 380 |
| 1.80 | 12 | 2.30 | 75 | 2.80 | 210 | | |
| 1.90 | 20 | 2.40 | 97 | 2.90 | 245 | | |
| 2.00 | 30 | 2.50 | 121 | 3.00 | 285 | | |

The above table is based on five discharge measurements made during 1905. It is well defined.

*Estimated monthly discharge of Gallinas River near Las Vegas, N. Mex., for 1904-1905.*

[Drainage area, 90 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| **1904.** | | | | | | |
| October 8-31 | 210 | 2 | 32.6 | 1,551 | 0.362 | 0.323 |
| November | 57 | 4 | 13.7 | 815 | .152 | .170 |
| December | 20 | 2 | 10.2 | 627 | .113 | .130 |
| **1905.** | | | | | | |
| January | 12 | 12 | 12.0 | 738 | .133 | .153 |
| February | 178 | 12 | 40.1 | 2,227 | .446 | .464 |
| March | 210 | 57 | 93.3 | 5,737 | 1.04 | .120 |
| April | 380 | 75 | 177 | 10,530 | 1.97 | 2.20 |
| May | 380 | 121 | 206 | 12,670 | 2.29 | 2.64 |
| June | 163 | 20 | 63.4 | 3,773 | .704 | .786 |
| July | 75 | 12 | 17.1 | 1,051 | .190 | .219 |
| August | 75 | 12 | 26.7 | 1,642 | .297 | .342 |
| September | 57 | 6 | 14.0 | 833 | .156 | .174 |
| October | 12 | 2 | 3.5 | 215 | .039 | .045 |
| November | 308 | 2 | 32.1 | 1,910 | .357 | .398 |
| December | 30 | 12 | 18.7 | 1,150 | .208 | .240 |
| The year | 380 | 2 | 57.8 | 42,480 | .652 | 7.78 |

NOTE.—From January 1 to September 27, 1904, the discharge was practically nothing, the water not being sufficient for current meter measurements. Discharge from September 29 to October 7, 1904, inclusive, was 16,570 acre-feet. Taken from G. B. Monk's report of floods in northern New Mexico in 1904. See also Water-Supply Paper No 147, Destructive Floods in United States in 1904, by E. C. Murphy.

## HONDO RIVER AT ROSWELL, N. MEX.

This station was established April 25, 1903, by W. M. Reed. It is located at the bridge at the intersection of Main and Vegas streets, Roswell, N. Mex.

The channel is nearly straight for 50 feet above and 450 feet below the bridge and has a width at ordinary high stages of 40 feet. The current has a moderate velocity. Both banks are low and overgrown with weeds, but are not liable to overflow. The bed of the stream is sandy loam, fairly permanent, and free from vegetation. There is but one channel at all stages.

Discharge measurements are made from the highway bridge. The initial point for soundings is a zero marked on the east stringer at the north end of the bridge.

In July, 1905, the channel of the river was widened at the street crossing and the original gage was torn out by the workman. August 8, 1905, a new inclined gage was placed on the left bank at the upstream side of bridge. It consists of a timber spiked to stakes driven in the bank, and the upper end is bolted to a sill of the bridge. During 1905 the gage was read by members of the Geological Survey office force at Roswell. Bench marks were established as follows: (1) The top of eyebar on west side of bridge; elevation, 7.45 feet. (2) The southeast corner of the cement sidewalk 25 feet northwest of bridge; elevation, 7.82 feet. (3) The top step near stone column at the entrance to the office of the Pecos Valley Lumber Company; elevation, 3.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers the United States Geological Survey:

Description: 99, pp 361-362; 132, pp 118-119.
Discharge: 99, p 362; 132, p 119.
Gage heights: 99, p 362; 132, p 119.

*Discharge measurements of Hondo River at Roswell, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 13 | J. M. Giles | 11 | 6 | 1.07 | 0.10 | 6 |
| April 25 | E. Patterson | 26 | 93 | 3.71 | 5.20 | 345 |
| April 25 | .....do | 27 | 102 | 3.74 | 5.60 | 383 |
| April 25 | W. A. Wilson | | 98 | 4.36 | 6.00 | 429 |
| April 26 | E. Patterson | 26 | 84 | 3.62 | 4.80 | 306 |
| April 26 | .....do | 24 | 77 | 3.53 | 4.50 | 271 |
| April 26 | .....do | 26 | 88 | 4.03 | 4.95 | 356 |
| April 27 | .....do | 24 | 69 | 3.00 | 4.20 | 206 |
| May 13 | .....do | 14 | 27 | 2.92 | 1.75 | 78 |
| May 17 | J. M. Giles | 14 | 15 | 2.51 | 1.10 | 38 |
| July 24 | E. Patterson | 30 | 131 | 4.20 | 5.00 | 551 |
| July 24 | .....do | 24 | 82 | 3.79 | 3.20 | 311 |
| July 25 | .....do | 30 | 134 | 4.09 | 5.00 | 550 |
| July 26 | .....do | 32 | 159 | 4.27 | 5.90 | 682 |
| July 26 | .....do | 32 | 156 | 4.15 | 5.60 | 648 |
| July 27 | .....do | 30 | 125 | 3.95 | 4.75 | 495 |
| July 28 | .....do | 27 | 110 | 3.72 | 4.00 | 409 |
| July 31 | .....do | 22 | 49 | 3.41 | 2.00 | 166 |
| August 2 | J. M. Giles | 24 | 65 | 3.59 | 2.50 | 234 |
| August 2 | .....do | 20 | 54 | 3.10 | 1.85 | 169 |
| August 8 | E. Patterson | 21 | 50 | 3.83 | 2.10 | 192 |
| August 15 | .....do | 19 | 32 | 3.61 | 1.50 | 116 |
| August 26 | .....do | 13 | 10 | 2.18 | − .10 | 22 |
| August 28 | .....do | 4 | 2 | .64 | −1.10 | 1.2 |
| September 8 | .....do | 8 | 3 | .93 | − .90 | 3 |
| September 11 | .....do | 14 | 23 | 2.94 | .75 | 68 |
| October 4 | .....do | 8 | 1.6 | .71 | −1.00 | 1.2 |
| November 10 | .....do | | 22 | 2.42 | .80 | 52 |
| November 29 | .....do | | 103 | 3.82 | 3.95 | 394 |
| December 3 | .....do | | 36 | 3.50 | 1.35 | 124 |
| December 9 | .....do | 21 | 20 | 2.58 | .40 | 51 |
| December 23 | .....do | 20 | 15 | 2.47 | .20 | 36 |

## HONDO RIVER AT HONDO RESERVOIR SITE, NEW MEXICO.

This station was established March 9, 1903, by W. A. Wilson. It is located at the first New Mexico reservoir dam site, 12 miles southwest of Roswell, N. Mex.

The channel is straight for 200 feet above and below the station. The current is swift at high water and sluggish at low water. Both banks are high, without trees, and liable to overflow. There is but one channel at all stages. The bed is composed of shifting sand and the cross section changes during each flood.

A footbridge has been constructed 75 feet below the dam, for the purpose of making discharge measurements. The initial point for soundings is 1 foot south of the north end of the west stringer of the bridge.

The gage is a vertical timber located 10 feet north of the footbridge. During 1905 the gage was read twice each day by Lee Hall. The bench-mark is on a ledge of rock which bears S. 45° W., and is 650 feet distant from the gage; elevation, 19.10 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 99, p 362; 132, pp 119-120.
Discharge: 99, p 363; 132, p 120.
Gage heights: 99, p 363; 132, p 121.

*Discharge measurements of Hondo River at Hondo reservoir site, New Mexico, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 24 | H. C. Hurd | 23 | 26 | 3.77 | 3.25 | 96 |
| February 26 | H. L. Eames | 23 | 48 | 3.84 | 4.35 | 184 |
| March 3 | do | 24 | 58 | 6.95 | 5.70 | 400 |
| March 5 | do | 24 | 74 | 7.26 | 6.58 | 536 |
| March 8 | do | 24 | 62 | 7.07 | 6.00 | 436 |
| March 15 | do | 23 | 37 | 4.45 | 4.85 | 166 |
| March 24 | do | 24 | 34 | 2.33 | 3.38 | 78 |
| March 25 | do | 24 | 28 | 2.34 | 3.20 | 66 |
| March 27 | do | 24 | 31 | 2.04 | 3.10 | 63 |
| March 29 | do | 24 | 32 | 2.39 | 3.20 | 77 |
| April 1 | do | 24 | 29 | 2.17 | 2.90 | 62 |
| April 6 | do | 18 | 18 | 1.88 | 2.30 | 33 |
| April 10 | do | 15 | 9.5 | 1.31 | 1.77 | 12 |
| April 14 | Giles and Eames | 24 | 32 | 2.20 | 2.90 | 71 |
| April 25 | H. L. Eames | 30 | 205 | 7.05 | 9.80 | 1,446 |
| April 29 | do | 25 | 170 | 6.83 | 8.40 | 1,158 |
| May 18 | J. M. Giles | | 45 | 2.32 | 3.22 | 105 |
| July 26 | E. Patterson | 31 | 177 | 4.28 | 9.70 | 758 |
| July 29 | do | 25 | 125 | 5.73 | 7.80 | 714 |
| August 2 | do | 23 | 33 | 4.01 | 3.60 | 132 |
| August 7 | do | 23 | 39 | 4.80 | 3.80 | 188 |
| August 10 | do | 23 | 51 | 5.60 | 5.40 | 285 |
| August 29 | do | 23 | 14 | 1.91 | 3.30 | 26 |
| September 10 | do | | 13 | 2.54 | 3.40 | 33 |
| September 16 | J. M. Giles | | 11 | 1.72 | 3.20 | 19 |
| October 5 | E. Patterson | 20 | 9 | 1.96 | 3.12 | 18 |
| October 14 | do | 12 | 6 | 1.09 | 2.95 | 7 |
| October 14 | J. M. Giles | 11 | 7.2 | 1.47 | 2.97 | 10.6 |
| October 24 | E. Patterson | 14 | 7 | 1.65 | 3.10 | 11.6 |
| November 29 | do | | 106 | 5.23 | 8.00 | 556 |
| December 1 | do | | 44 | 5.27 | 5.35 | 232 |
| December 26 | do | | | | 5.00 | [a]20 |

[a] Estimated through ice and snow.

*Daily gage height, in feet, of Hondo River at Hondo reservoir site, New Mexico, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.95 | ....... | 4.6 | 2.9 | 7.5 | 1.45 | ....... | 6.55 | 2.9 | 3.1 | 3.1 | 5.35 |
| 2 | .9 | ....... | 5.0 | 2.8 | 7.95 | 2.05 | 4.3 | 3.75 | 2.9 | 3.2 | 3.05 | 4.9 |
| 3 | .9 | ....... | 5.7 | 2.65 | 8.0 | 1.75 | 4.0 | 7.9 | 2.8 | 3.25 | 3.0 | 4.55 |
| 4 | .9 | ....... | 6.65 | 2.6 | 7.3 | 1.75 | 3.9 | 4.5 | 3.15 | 3.25 | 3.0 | 4.4 |
| 5 | .9 | ....... | 6.6 | 2.4 | 6.85 | 2.0 | 3.8 | 3.95 | 3.25 | 3.1 | 3.0 | 4.05 |
| 6 | .85 | ....... | 6.2 | 2.3 | 6.35 | 1.8 | ....... | 3.85 | 3.7 | 3.1 | 3.15 | 3.85 |
| 7 | .9 | ....... | 6.05 | 2.1 | 5.85 | 1.85 | ....... | 4.1 | 3.4 | 3.05 | 3.35 | 3.6 |
| 8 | .95 | ....... | 5.9 | 1.95 | 5.45 | 1.7 | ....... | 4.3 | 3.45 | 3.0 | 3.3 | 3.1 |
| 9 | .85 | ....... | 5.55 | 1.8 | 4.95 | 7.8 | ....... | 6.75 | 3.35 | 3.0 | 3.45 | 3.3 |
| 10 | .85 | ....... | 5.25 | 1.9 | 5.0 | 7.95 | ....... | 5.6 | 3.6 | 3.0 | 3.8 | 3.4 |
| 11 | .9 | ....... | 5.1 | 2.25 | 4.55 | 7.45 | ....... | 5.85 | 3.95 | 3.0 | 3.85 | 3.35 |
| 12 | 2.3 | ....... | 4.95 | 2.95 | 4.05 | 10.5 | ....... | 7.05 | 3.5 | 3.0 | 3.8 | 3.4 |
| 13 | 1.9 | ....... | 4.9 | 2.95 | 3.75 | 5.95 | ....... | 4.7 | 3.3 | 3.0 | 3.65 | 3.4 |
| 14 | 1.65 | ....... | 4.75 | 2.75 | 3.6 | 5.25 | ....... | 5.4 | 3.2 | 3.0 | 3.65 | 3.35 |
| 15 | 1.55 | ....... | 4.8 | 2.55 | 3.55 | 5.15 | ....... | 5.05 | 3.2 | 2.9 | 3.5 | 3.2 |
| 16 | 1.55 | ....... | 4.6 | 2.35 | 3.25 | 5.15 | ....... | 5.3 | 3.15 | 2.9 | 3.45 | 3.1 |
| 17 | 1.5 | ....... | 4.6 | 2.4 | 3.0 | 5.1 | ....... | 4.65 | 3.05 | 3.0 | 3.4 | 3.1 |
| 18 | 1.4 | ....... | 4.5 | 2.3 | 3.05 | 5.1 | ....... | 4.4 | 3.05 | 2.9 | 3.3 | 3.0 |
| 19 | 1.3 | ....... | 4.35 | 2.5 | 3.05 | 4.9 | ....... | 4.15 | 2.95 | 2.95 | 3.35 | 3.0 |
| 20 | 1.3 | 2.65 | 4.1 | 2.85 | 3.15 | 4.9 | ....... | 4.0 | 2.9 | 2.95 | 3.35 | 2.9 |
| 21 | 1.7 | 2.75 | 3.9 | 3.05 | 4.1 | 4.8 | ....... | 3.95 | 2.95 | 3.0 | 3.35 | 2.9 |
| 22 | 1.2 | 2.95 | 3.75 | 2.75 | 3.55 | 4.7 | ....... | 3.85 | 2.55 | 3.0 | 3.35 | 3.0 |
| 23 | 1.2 | 3.05 | 3.55 | 3.1 | 3.1 | 4.7 | 6.3 | 4.2 | 2.85 | 3.05 | 3.45 | 3.2 |
| 24 | ....... | 3.25 | 3.3 | 3.2 | 2.9 | 4.55 | 8.05 | 4.2 | 2.9 | 3.05 | 3.3 | 4.0 |
| 25 | ....... | 4.25 | 3.2 | 9.1 | 2.65 | 4.4 | 11.4 | 3.9 | 2.75 | 3.15 | 3.3 | 4.3 |
| 26 | ....... | 4.25 | 3.1 | 7.4 | 2.55 | 4.35 | 9.2 | 3.6 | 3.65 | 3.1 | 3.3 | 4.7 |
| 27 | ....... | 4.4 | 3.1 | 7.95 | 2.4 | 4.15 | 8.55 | 3.2 | 3.4 | 3.1 | 3.25 | 4.35 |
| 28 | ....... | 4.6 | 3.15 | 8.8 | 2.25 | 3.9 | 7.0 | 3.2 | 3.6 | 3.05 | 6.7 | 4.2 |
| 29 | ....... | ....... | 3.2 | 8.45 | 2.15 | 3.75 | 6.5 | 3.15 | 3.45 | 3.1 | 8.7 | 4.5 |
| 30 | ....... | ....... | 3.2 | 8.25 | 2.05 | ....... | 4.15 | 3.15 | 3.2 | 3.0 | 6.0 | 4.5 |
| 31 | ....... | ....... | 2.6 | ....... | 1.75 | ....... | 4.35 | 3.15 | ....... | 3.05 | ....... | 4.8 |

NOTE.—River dry on days of no gage height.

## TAYLOR-MOORE DITCH NEAR ROSWELL, N. MEX.

This station was established March 23, 1905, and discontinued June 8, 1905. It is located between the diversion dam and reservoir site, 12 miles southwest of Roswell. The ditch takes water from Hondo River 2 miles above the Hondo River gaging station.

The channel is straight for 1,000 feet above and below the station and the current is swift. Discharge measurements are made by wading or from a plank thrown across the ditch at the gage. A staff gage is driven into the bank of the ditch. During 1905 the gage was read daily by H. L. Eames.

*Discharge measurements of Taylor-Moore ditch near Roswell, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 3 | H. L. Eames | 7 | 5.4 | 3.02 | 1.45 | 16.3 |
| April 6 | do | 7 | 4.0 | 2.23 | 1.20 | 8.9 |
| April 10 | do | 7 | 6.4 | 3.29 | 1.62 | 21.2 |
| April 14 | J. M. Giles | 7 | 7.0 | 3.73 | 1.72 | 26.1 |

*Daily gage height, in feet, of Taylor-Moore ditch near Roswell, N. Mex., for 1905.*

| Day. | Apr. | May. | June. | Day. | Apr. | May. | June. | Day. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | ...... | 1.6 | 12 | 1.71 | 1.9 | ...... | 23 | 1.88 | 1.5 | ...... |
| 2 | ...... | ...... | 1.7 | 13 | 1.72 | 1.9 | ...... | 24 | 1.9 | 1.5 | ...... |
| 3 | 1.45 | ...... | 1.8 | 14 | 1.72 | 1.9 | ...... | 25 | ...... | 1.4 | ...... |
| 4 | 1.47 | ...... | 1.9 | 15 | 1.75 | 1.9 | ...... | 26 | ...... | 1.3 | ...... |
| 5 | 1.35 | ...... | 1.9 | 16 | 1.72 | 1.8 | ...... | 27 | ...... | 1.2 | ...... |
| 6 | 1.2 | ...... | 1.9 | 17 | 1.72 | 1.81 | ...... | 28 | ...... | 1.15 | ...... |
| 7 | 1.0 | ...... | 1.9 | 18 | 1.75 | 1.82 | ...... | 29 | ...... | 1.1 | ...... |
| 8 | 1.28 | ...... | 1.9 | 19 | 1.78 | 1.92 | ...... | 30 | ...... | .7 | ...... |
| 9 | 1.6 | 1.5 | ...... | 20 | 1.78 | 1.83 | ...... | 31 | ...... | 1.2 | ...... |
| 10 | 1.63 | 1.92 | ...... | 21 | 1.82 | 1.92 | ...... | | | | |
| 11 | 1.69 | 1.91 | ...... | 22 | 1.84 | 1.6 | ...... | | | | |

NOTE.—Dam broke April 25; rebuilt May 8. Ditch dry April 25 to May 8. Dam washed out June 9; ditch dry.

*Station rating table for Taylor-Moore ditch near Roswell, N. Mex., from March 23 to June 8, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.70 | 0.3 | 1.10 | 6.7 | 1.50 | 17.6 | 1.90 | 33 |
| .80 | 1.7 | 1.20 | 8.9 | 1.60 | 21.2 | 2.00 | 37 |
| .90 | 3.2 | 1.30 | 11.4 | 1.70 | 25 | | |
| 1.00 | 4.8 | 1.40 | 14.4 | 1.80 | 29 | | |

The above table is based on four discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 1.7 feet.

*Estimated monthly discharge of Taylor-Moore ditch near Roswell, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 23–31 | 16 | 6 | 12.1 | 216 |
| April | 33 | 0 | 17.9 | 1,065 |
| May | 34 | 0 | 16.7 | 1,027 |
| June 1–8 | 33 | 21 | 30.0 | 476 |

NOTE.—March 23 to April 2 discharge estimated. Ditch dry April 25 to May 8 and after June 8.

## PENASCO RIVER NEAR DAYTON, N. MEX.

This station was established September 12, 1905. It is located about 2 miles east and 1 mile north of Dayton and about 1 mile above the mouth of the river. Both banks are high, but are subject to overflow. The bed of the stream is composed of gravel and is slightly shifting. The current has a good velocity. Discharge measurements are made by wading near the gage.

The gage is in two sections: An inclined scale fastened to stakes driven into the left bank reads from 0 to 5.5 feet. A vertical section nailed to a post at the end of the inclined scale reads from 5.5 to 7.5 feet. During 1905 the gage was read once each day by Eugene Lattion. Bench marks were established as follows: (1) The top of post to which gage is fastened; elevation, 7.38 feet. (2) A nail in post at corner of fence on right bank opposite the gage; elevation, 9.82 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Penasco River near Dayton, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 12 | J. M. Giles | 16 | 7.8 | 0.95 | 1.00 | 7.4 |
| September 15 | E. Patterson | 8 | 4.4 | 1.00 | .90 | 4.4 |
| October 4 | J. M. Giles | 12 | 6.8 | .68 | .95 | 4.6 |
| October 15 | E. Patterson | 13 | 7.7 | .70 | .95 | 5.4 |
| November 23 | J. M. Giles | ........ | 52 | 2.93 | 1.80 | 151 |
| November 23 | .....do | ........ | 34 | 2.08 | 1.47 | 71 |
| November 23 | .....do | ........ | 21 | 2.56 | 1.37 | 53 |
| November 28 | .....do | ........ | 22 | 1.67 | 1.15 | 20 |

*Daily gage height, in feet, of Penasco River near Dayton, N. Mex., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.9 | 1.0 | 1.6 | 12 | 1.0 | 1.0 | 1.0 | 1.4 | 23 | .8 | 1.0 | 1.55 | 1.5 |
| 2 | ...... | .9 | 1.0 | 1.9 | 13 | .8 | 1.0 | 1.0 | 1.4 | 24 | .9 | 1.0 | 1.3 | 1.5 |
| 3 | ...... | 1.0 | 1.0 | 1.5 | 14 | .6 | 1.0 | 1.0 | 1.5 | 25 | 1.0 | 1.0 | 1.2 | 1.3 |
| 4 | ...... | 1.0 | 1.3 | 1.6 | 15 | .95 | 1.0 | 1.0 | 1.5 | 26 | .9 | 1.0 | 1.2 | 1.2 |
| 5 | ...... | 1.0 | 1.5 | 1.6 | 16 | 1.0 | 1.0 | 1.0 | 1.5 | 27 | 1.0 | 1.0 | 1.1 | 1.4 |
| 6 | ...... | 1.0 | 1.0 | 1.6 | 17 | 1.0 | 1.0 | 1.0 | 1.5 | 28 | .9 | 1.0 | 1.8 | 1.4 |
| 7 | ...... | .9 | 1.0 | 1.5 | 18 | 1.0 | 1.0 | 1.0 | 1.5 | 29 | .9 | 1.0 | 1.7 | 1.3 |
| 8 | ...... | 1.0 | 1.0 | 1.5 | 19 | 1.0 | 1.0 | 1.0 | 1.5 | 30 | .9 | 1.0 | 1.7 | 1.2 |
| 9 | ...... | 1.0 | 1.0 | 1.4 | 20 | 1.0 | 1.0 | 1.0 | 1.5 | 31 | ...... | 1.0 | ...... | 1.8 |
| 10 | ...... | 1.0 | 1.0 | 1.4 | 21 | 1.5 | 1.0 | 1.0 | 1.5 | | | | | |
| 11 | ...... | 1.0 | 1.0 | 1.4 | 22 | .9 | 1.0 | 1.0 | 1.5 | | | | | |

*Station rating table for Penasco River near Dayton, N. Mex., from September 12, 1905, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 1 | 1.00 | 7 | 1.40 | 57 | 1.80 | 150 |
| .70 | 2 | 1.10 | 15 | 1.50 | 77 | 1.90 | 180 |
| .80 | 3 | 1.20 | 26 | 1.60 | 99 | | |
| .90 | 5 | 1.30 | 40 | 1.70 | 123 | | |

The above table is based on eight discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 1.8 feet.

*Estimated monthly discharge of Penasco River near Dayton, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| September 12-30 | 77 | 1 | 9.3 | 351 |
| October | 7 | 5 | 6.8 | 418 |
| November | 150 | 7 | 28.3 | 1,684 |
| December | 180 | 26 | 75.3 | 4,630 |

### DEVILS RIVER AT DEVILS RIVER, TEX.

This station was established in April, 1900, by the International (Water) Boundary Commission. It is opposite the Southern Pacific Railroad station at Devils River.

The river is about 50 miles in length, has a perennial flow, and during flood periods is subject to great fluctuations. No good location for a gaging station exists on this stream where it would be accessible from the railroad station. At the site chosen, the river is straight for one-fourth mile both above and below the station.* The right bank is the talus of a cliff, the left bank is a bottom heavily timbered. The bed of the stream is nearly all a rock ledge, but seamed and faulted so as to be rough. The currents change in such a way as to give materially different discharges for the same gage height.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the cable support on the left bank.

The gage is a scantling spiked vertically to a tree. The highest water on record occurred April 6, 1900, about two weeks before this gage was established. It reached a height of 25.4 feet on the gage, but this is 8 feet higher than any other known flood. Low water is 2 feet on the gage. The bench mark is a nail in the side of the gate post near the railroad station; elevation, 31.26 feet above the datum of the gage.

The observations during 1905 have been made under the direction of the United States section of the International (Water) Boundary Commission. The hydrographer is E. E. Winter, and the gage reader is John Harrison.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, pp 363–364; 66, p 79; 84, p 164; 99, p 348; 132, p 122.
Discharge: WS 28, p 130; 50, p 364; 66, p 79; 84, p 164; 99, pp 349–350; 132, pp 123–124.
Discharge, mean daily: WS 132, p 125.
Discharge, monthly: Ann 22, iv, p 356; WS 75, p 161; 84, p 165; 99, p 351; 132, p 125.
Gage heights: WS 50, p 364; 66, p 79; 84, p 165; 99, pp 350–351; 132, p 124.

*Discharge measurements of Devils River at Devils River, Tex., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 9 | E. E. Winter | 347 | 1.30 | 2.3 | 452 |
| January 17 | do | 347 | 1.29 | 2.3 | 448 |
| January 25 | do | 347 | 1.28 | 2.3 | 444 |
| January 30 | do | 347 | 1.22 | 2.25 | 424 |
| February 8 | do | 348 | 1.23 | 2.3 | 429 |
| February 16 | do | 348 | 1.24 | 2.3 | 432 |
| February 27 | do | 351 | 1.24 | 2.3 | 437 |
| March 13 | do | 351 | 1.35 | 2.35 | 475 |
| March 17 | do | 444 | 1.71 | 2.6 | 761 |
| March 21 | do | 407 | 1.67 | 2.5 | 680 |
| March 25 | do | 376 | 1.45 | 2.4 | 544 |
| March 30 | do | 375 | 1.44 | 2.4 | 540 |
| April 5 | do | 433 | 1.58 | 2.65 | 682 |
| April 13 | do | 404 | 1.49 | 2.5 | 600 |
| April 18 | do | 378 | 1.41 | 2.4 | 533 |
| April 25 | do | 1,079 | 2.94 | 4.9 | 3,168 |
| April 30 | do | 724 | 2.18 | 3.5 | 1,580 |
| May 4 | do | 491 | 1.62 | 2.8 | 795 |
| May 12 | do | 468 | 1.48 | 2.7 | 691 |
| May 17 | do | 468 | 1.51 | 2.7 | 706 |
| May 25 | do | 461 | 1.77 | 2.7 | 816 |
| May 30 | do | 465 | 2.00 | 2.7 | 928 |
| June 5 | do | 490 | 1.90 | 2.8 | 929 |

*Discharge measurements of Devils River at Devils River, Tex., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 14 | E. E. Winter | 461 | 1.78 | 2.7 | 822 |
| June 22 | do | 462 | 1.78 | 2.7 | 823 |
| June 26 | do | 459 | 1.74 | 2.7 | 797 |
| June 30 | do | 518 | 2.02 | 2.9 | 1,045 |
| July 6 | do | 457 | 1.82 | 2.7 | 830 |
| July 11 | do | 446 | 1.65 | 2.65 | 736 |
| July 16 | do | 403 | 1.50 | 2.55 | 606 |
| July 21 | do | 411 | 1.42 | 2.55 | 582 |
| July 27 | do | 404 | 1.39 | 2.5 | 562 |
| July 30 | do | 401 | 1.38 | 2.5 | 553 |
| August 7 | do | 406 | 1.40 | 2.5 | 567 |
| August 11 | do | 407 | 1.39 | 2.5 | 565 |
| August 16 | do | 402 | 1.35 | 2.5 | 541 |
| August 22 | do | 401 | 1.39 | 2.5 | 559 |
| August 25 | do | 402 | 1.43 | 2.5 | 574 |
| August 30 | do | 403 | 1.38 | 2.5 | 558 |
| September 4 | do | 552 | 1.80 | 3.0 | 996 |
| September 18 | do | 405 | 1.67 | 2.5 | 675 |
| September 23 | do | 403 | 1.66 | 2.5 | 670 |
| September 26 | do | 403 | 1.63 | 2.5 | 657 |
| September 29 | do | 405 | 1.62 | 2.5 | 658 |
| October 4 | do | 403 | 1.54 | 2.5 | 621 |
| October 12 | do | 403 | 1.45 | 2.5 | 586 |
| October 17 | do | 402 | 1.41 | 2.5 | 566 |
| October 25 | do | 396 | 1.23 | 2.45 | 486 |
| October 30 | do | 401 | 1.27 | 2.5 | 511 |
| November 4 | do | 396 | 1.28 | 2.5 | 508 |
| November 11 | do | 396 | 1.27 | 2.5 | 501 |
| November 16 | do | 401 | 1.26 | 2.5 | 505 |
| November 24 | do | 396 | 1.23 | 2.5 | 489 |
| November 30 | do | 396 | 1.60 | 2.5 | 634 |
| December 5 | H. F. Collins | 372 | 1.54 | 2.45 | 573 |
| December 10 | do | 372 | 1.59 | 2.45 | 592 |
| December 18 | do | 365 | 1.62 | 2.45 | 591 |
| December 26 | do | 365 | 1.62 | 2.45 | 593 |

*Daily gage height, in feet, of Devils River at Devils River, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 2.3 | 2.3 | 6.0 | 4.1 | 2.85 | 2.95 | 2.5 | 2.5 | 2.7 | 2.5 | 2.45 |
| 2 | 2.3 | 2.3 | 2.3 | 3.65 | 3.5 | 2.8 | 2.8 | 2.5 | 2.5 | 3.1 | 2.5 | 2.45 |
| 3 | 2.3 | 2.3 | 2.3 | 2.9 | 3.0 | 2.85 | 2.8 | 2.5 | 3.2 | 2.85 | 2.5 | 2.45 |
| 4 | 2.3 | 2.3 | 2.3 | 2.8 | 2.85 | 2.95 | 2.7 | 2.5 | 3.1 | 2.55 | 2.5 | 2.45 |
| 5 | 2.3 | 2.3 | 2.3 | 2.7 | 2.8 | 2.8 | 2.7 | 2.5 | 2.7 | 2.5 | 2.5 | 2.45 |
| 6 | 2.3 | 2.3 | 2.3 | 2.7 | 2.8 | 2.8 | 2.7 | 2.5 | 2.6 | 2.5 | 2.5 | 2.45 |
| 7 | 2.3 | 2.3 | 2.35 | 2.6 | 2.7 | 2.7 | 2.7 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 8 | 2.3 | 2.3 | 2.35 | 2.6 | 2.7 | 2.65 | 2.7 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 9 | 2.3 | 2.3 | 2.35 | 2.55 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 10 | 2.3 | 2.3 | 2.35 | 2.55 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 11 | 2.3 | 2.3 | 2.35 | 2.55 | 2.7 | 2.6 | 2.65 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 12 | 2.3 | 2.3 | 2.35 | 2.5 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 13 | 2.3 | 2.3 | 2.35 | 2.45 | 2.7 | 2.65 | 2.6 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 14 | 2.3 | 2.3 | 2.35 | 2.5 | 2.85 | 2.7 | 2.55 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 15 | 2.3 | 2.3 | 2.35 | 2.5 | 2.75 | 2.7 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 16 | 2.3 | 2.3 | 2.7 | 2.5 | 2.7 | 2.7 | 2.55 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 17 | 2.3 | 2.3 | 2.6 | 2.45 | 2.65 | 2.7 | 2.55 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 18 | 2.3 | 2.3 | 2.6 | 2.4 | 2.5 | 2.7 | 2.55 | 2.5 | 2.55 | 2.5 | 2.5 | 2.45 |
| 19 | 2.3 | 2.3 | 2.6 | 2.4 | 2.5 | 2.7 | 2.55 | 2.5 | 3.8 | 2.5 | 2.5 | 2.45 |
| 20 | 2.3 | 2.3 | 2.6 | 2.4 | 2.5 | 2.7 | 2.55 | 2.5 | 2.75 | 2.8 | 2.5 | 2.45 |
| 21 | 2.3 | 2.3 | 2.5 | 2.4 | 2.5 | 2.9 | 2.55 | 2.5 | 2.5 | 2.5 | 2.5 | 2.45 |
| 22 | 2.3 | 2.3 | 2.5 | 2.4 | 2.5 | 2.7 | 2.55 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 23 | 2.3 | 2.3 | 2.5 | 2.55 | 2.5 | 2.7 | 2.55 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 24 | 2.3 | 2.3 | 2.5 | 3.1 | 2.75 | 2.7 | 2.55 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 25 | 2.3 | 2.3 | 2.4 | 4.9 | 2.7 | 2.7 | 2.55 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 26 | 2.3 | 2.3 | 2.4 | 4.9 | 2.8 | 2.7 | 2.55 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 27 | 2.3 | 2.3 | 2.4 | 2.9 | 2.9 | 2.7 | 2.5 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 28 | 2.3 | 2.3 | 2.4 | 2.7 | 2.85 | 2.8 | 2.5 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 29 | 2.3 | ...... | 2.4 | 2.6 | 2.7 | 5.0 | 2.5 | 2.5 | 2.5 | 2.45 | 2.5 | 2.45 |
| 30 | 2.25 | ...... | 2.4 | 4.2 | 2.7 | 3.25 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.4 |
| 31 | 2.25 | ...... | 2.4 | ...... | 3.25 | ...... | 2.5 | 2.5 | ...... | 2.5 | ...... | 2.4 |

*Daily discharge, in second-feet, of Devils River at Devils River, Tex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 445 | 440 | 435 | 6,470 | 2,260 | 990 | 1,090 | 555 | 570 | 770 | 510 | 575 |
| 2 | 445 | 440 | 440 | 1,750 | 1,590 | 930 | 940 | 560 | 580 | 1,100 | 510 | 575 |
| 3 | 445 | 435 | 440 | 840 | 1,020 | 990 | 930 | 560 | 1,200 | 870 | 510 | 575 |
| 4 | 450 | 435 | 440 | 770 | a 850 | 1,110 | 830 | 560 | a1,100 | a 650 | a 510 | 575 |
| 5 | 450 | 435 | 445 | a 710 | 795 | a 930 | a 830 | 565 | 750 | 615 | 510 | a 575 |
| 6 | 450 | 430 | 445 | 710 | 795 | 930 | 825 | 565 | 680 | 610 | 510 | 580 |
| 7 | 450 | 430 | 470 | 655 | 690 | 820 | 820 | a 565 | 620 | 605 | 505 | 585 |
| 8 | 450 | a 430 | 470 | 655 | 690 | 770 | 810 | 565 | 620 | 600 | 505 | 585 |
| 9 | a 450 | 430 | 470 | 630 | 690 | 720 | 705 | 565 | 630 | 595 | 505 | 590 |
| 10 | 450 | 430 | 470 | 630 | 690 | 720 | 700 | 565 | 630 | 590 | 500 | a 590 |
| 11 | 450 | 430 | 475 | 630 | 690 | 720 | a 735 | a 565 | 640 | 585 | a 500 | 590 |
| 12 | 450 | 430 | 475 | 600 | a 690 | 720 | 680 | 565 | 640 | a 585 | 500 | 590 |
| 13 | 450 | 430 | a 475 | a 565 | 690 | 770 | 675 | 560 | 650 | 580 | 500 | 590 |
| 14 | 450 | 430 | 475 | 600 | 850 | a 820 | 620 | 555 | 650 | 575 | 505 | 590 |
| 15 | 450 | 430 | 475 | 600 | 750 | 820 | 570 | 550 | 660 | 570 | 505 | 590 |
| 16 | 450 | a 430 | 840 | 600 | 700 | 820 | a 605 | a 540 | 660 | 565 | a 505 | 590 |
| 17 | a 450 | 430 | a 760 | 565 | a 655 | 820 | 600 | 545 | 670 | a 565 | 505 | 590 |
| 18 | 450 | 430 | 760 | a 535 | 510 | 820 | 595 | 550 | a 720 | 555 | 505 | a 590 |
| 19 | 450 | 430 | 760 | 535 | 525 | 820 | 590 | 555 | 1,920 | 550 | 505 | 590 |
| 20 | 445 | 435 | 760 | 535 | 540 | 820 | 585 | 555 | 890 | 820 | 500 | 590 |
| 21 | 445 | 435 | a 680 | 535 | 555 | 1,040 | a 580 | 560 | 670 | 530 | 500 | 590 |
| 22 | 445 | 435 | 665 | 535 | 570 | a 820 | 580 | a 560 | 670 | 505 | 495 | 590 |
| 23 | 445 | 435 | 650 | 630 | 585 | 820 | 580 | 565 | a 670 | 500 | 495 | 590 |
| 24 | 445 | 435 | 635 | 1,010 | 850 | 810 | 580 | 570 | 660 | 490 | a 490 | 590 |
| 25 | a 445 | 435 | a 545 | a3,170 | a 815 | 810 | 580 | a 575 | 660 | a 485 | 500 | 590 |
| 26 | 445 | 435 | 545 | 3,170 | 940 | a 800 | 580 | 575 | a 655 | 485 | 520 | a 595 |
| 27 | 445 | a 435 | 545 | 840 | 1,060 | 800 | a 560 | 570 | 655 | 485 | 540 | 590 |
| 28 | 445 | 435 | 540 | 710 | 1,030 | 920 | 560 | 565 | 655 | 485 | 570 | 585 |
| 29 | 445 | ....... | 540 | 650 | 910 | 3,280 | 555 | 560 | a 660 | 485 | 600 | 580 |
| 30 | a 425 | ....... | a 540 | a2,370 | a 930 | a1,400 | a 555 | a 560 | 660 | a 510 | a 630 | 515 |
| 31 | 425 | ....... | 540 | ....... | 1,480 | ....... | 555 | 560 | ....... | 510 | ....... | 510 |

[a] Meter measurement.

*Estimated monthly discharge of Devils River at Devils River, Tex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 450 | 425 | 446 | 27,441 |
| February | 440 | 430 | 433 | 24,040 |
| March | 840 | 435 | 555 | 34,126 |
| April | 6,470 | 535 | 1,107 | 65,861 |
| May | 2,260 | 510 | 851 | 52,354 |
| June | 3,280 | 720 | 945 | 56,251 |
| July | 1,090 | 555 | 677 | 41,653 |
| August | 575 | 540 | 561 | 34,483 |
| September | 1,920 | 570 | 736 | 43,825 |
| October | 1,100 | 485 | 594 | 36,545 |
| November | 630 | 490 | 515 | 30,635 |
| December | 595 | 510 | 582 | 35,763 |
| The year | 6,470 | 425 | 667 | 482 977 |

## SAN FELIPE CREEK AT DEL RIO, TEX.

San Felipe Creek rises in four large springs northeast of Del Rio, and flows southward into the Rio Grande. The waters of these springs are used in two large irrigation systems, the one on the west side of the creek having been in use for many years, while the one on the east has only recently been constructed by G. Bedell Moore. The following table shows the discharge measurements that have been taken on the combined flow of the Madre ditch and the creek just south of the bridge of the Southern Pacific Railroad.

*Discharge measurements of San Felipe Creek at Del Rio, Tex., 1895–1905.*

| Date. | Hydrographer. | Discharge. | Remarks. |
|---|---|---|---|
| | | *Second-feet.* | |
| December, 1895 | C. C. Babb | 99 | |
| March, 1899 | T. U. Taylor | 113 | |
| September, 1900 | do | 149 | Rainy season. |
| December, 1901 | C. N. Campbell | 150 | After Brackett flood. |
| September, 1902 | T. U. Taylor | 115 | |
| March, 1904 | do | 118 | Includes 38 second-feet in ditch. |
| August, 1905 | do | 103 | |

## LAS MORAS CREEK NEAR BRACKETTVILLE, TEX.

Las Moras Creek, like its sister springs of the Edwards Plateau, rises very suddenly. It is located near the twin towns of Brackettville and Fort Clark, and threads its way between the two. It flows south, supporting many irrigation systems, and finally empties into the Rio Grande 25 miles above Eagle Pass. Its flow is extremely variable, being a reflex barometer of the season preceding, and like the Leona at Uvalde, it gives a safe index of the rainfall of the Edwards Plateau for months before. The following table shows the discharge measurements that have been taken:

*Discharge measurements of Las Moras Creek near Brackettville, Tex., 1895–1905.*

| Date. | Hydrographer. | Discharge. | Remarks. |
|---|---|---|---|
| | | *Second-feet.* | |
| December, 1895 | C. C. Babb | 21 | At footbridge, Brackettville. |
| June, 1899 | T. U. Taylor | 60 | At Mulligans Bend. |
| September, 1900 | do | 51 | Do. |
| September, 1902 | do | 11 | Do. |
| September, 1902 | do | 11 | Do. |
| March, 1904 | do | 28 | Do. |
| August, 1905 | do | 14 | Do. |

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1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

# REPORT

OF

# PROGRESS OF STREAM MEASUREMENTS

FOR

# THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

## PART XI.—Colorado River Drainage above Yuma

BY

**M. C. HINDERLIDER and G. L. SWENDSEN**

WASHINGTON
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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART XI.

By M. C. HINDERLIDER and G. L. SWENDSEN.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collecton of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gaging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

*Annual appropriations for hydrographic surveys, fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power special effort is made to obtain information concerning the minimum flow; if water is to be stored the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations and their records in connection with short series of measurements serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware River drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage above Yuma.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California and Colorado River drainage below Gila River.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

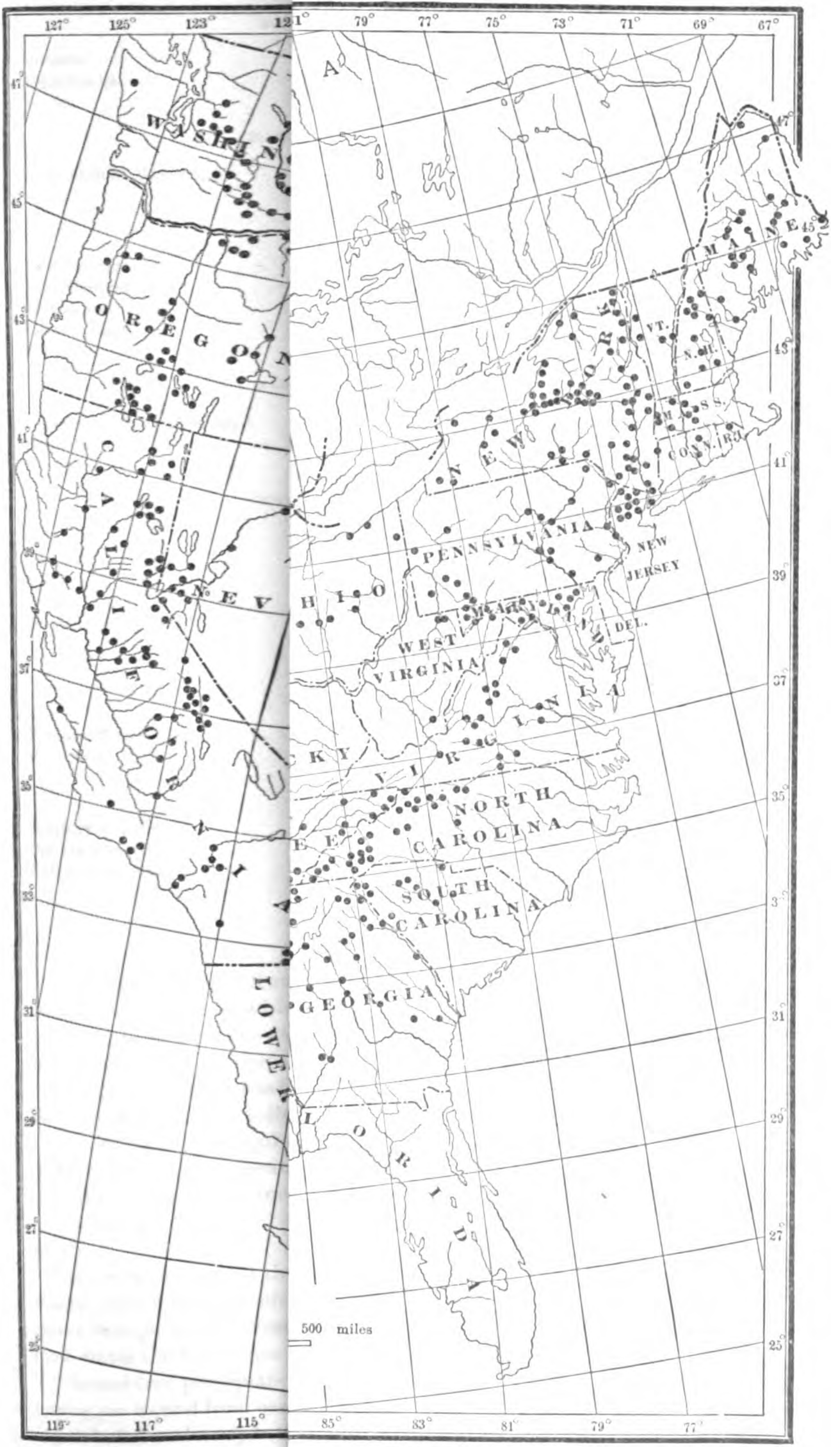
*List of drainage basins in the United States.*

NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.

SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor southern Atlantic.


127°
125°
123°
121°
79°
77°
75°
73°
71°
69°
67°
47°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
WASHINGTON
OREGON
CALIFORNIA
NEV
OHIO
LOWER
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
NEW YORK
PENNSYLVANIA
NEW JERSEY
MARYLAND
DEL.
WEST VIRGINIA
VIRGINIA
KY
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
500 miles
119°
117°
115°
85°
83°
81°
79°
77°

DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Applachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississipppi.
Missouri.
Meramec
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadalupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS

## DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharge," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is applied to the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rain fall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise, in the column of "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

*Special rules for computation.*

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; 0.125; 0.012; 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second, nearly.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec. ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\ l\sqrt{h^3}$; $l$=length of weir in inches; $h$=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:
Scale 1 : 125000, 1 mile=0.50688 inch.
Scale 1 : 90000, 1 mile=0.70400 inch.
Scale 1 : 62500, 1 mile=1.01376 inches.
Scale 1 : 45000, 1 mile=1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be devided with respect to their physical conditions into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$ which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of the water around and through the dam.

The physical requirements are as follows: (a) Sufficient height of dam, so that backwater will not interfere with free fall over it; (b) absence of leaks of appreciable magnitude; (c) topography or abutments which confine the flow over the dam at high stages; (d) level crests, which are kept free from obstructions caused by floating logs or ice; (e) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (f) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates, the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve for a critical stage of considerable duration the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

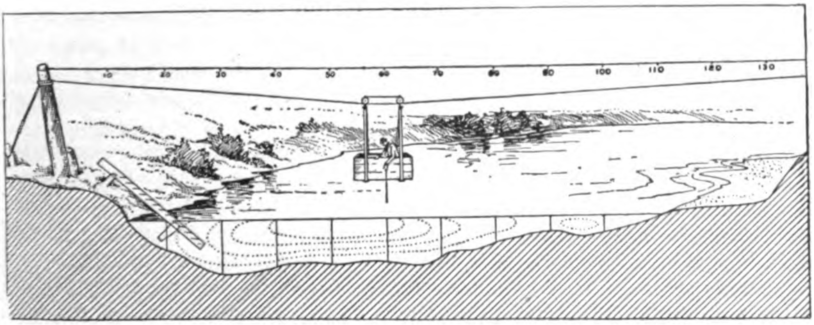


FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures usually referred to as "equipment" are generally appurtenant to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements, coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and conditions of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity curve, 0.2 and 0.8 depth, and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements taken on many streams under and varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95 depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point in the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141–148.

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

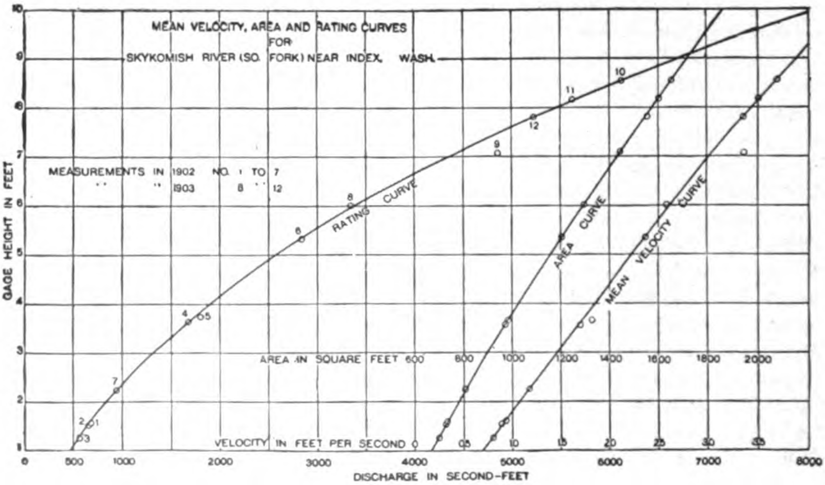


FIG. 2.—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remains constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The platting of results of the various discharge measurements, using gage heights as ordinates and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage heights or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method or a graphical application of it is also much used in estimating flow at stations where the bed shifts but slowly.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the district hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

*Arizona.*—District hydrographer, W. A. Farish,[a] assisted by H. S. Reed, W. Richins, O. Richins, R. H Ross, H. R. Fry, F. Asplind, Prof. G. E. P. Smith, R. L. Newman, and E. O. Blades.

*California.*—The hydrographic work of the United States Geological Survey in the Colorado River drainage in California has been carried on in cooperation with the State under the direction of Supervising Engineer J. B. Lippincott,[b] assisted by Engineer W. B. Clapp.

*Colorado.*—District and resident engineer, M. C. Hinderlider,[c] assisted by R. I. Meeker, William A. Lamb, H. G. Graham, A A. Weiland, O H. Timmerman, Melvin Beeson, Thomas E. Brick, and F. L. Meeker. Acknowledgments are due the Denver and Rio Grande, Colorado and Southern, Burlington and Missouri River, and Union Pacific railroads for transportation furnished to the district hydrographer and assistants. Acknowledgments are also due the Denver Union Water Company for the use of their reservoir as a rating station for current meters.

*Nevada.*—The hydrographic work in this section has been carried on in cooperation with the State by Henry Thurtell,[d] State engineer, assisted by W. A. Wolf, J. T. Shaw. R. A. Craig, O. F. Heizer, H. H. Church, and L. A. Woolley. Acknowledgment is due to the Southern Pacific Company for transportation furnished to the district hydrographer and assistants, and also to the San Pedro Los Angeles, and Salt Lake Railroad for transportation furnished to the State engineer.

*New Mexico.*—The hydrographic work in the northern portion of this Territory was carried on under the direction of the district hydrographer, M. C. Hinderlider, assisted by R. I. Meeker and O. H. Timmerman. Acknowledgments are due the Denver and Rio Grande Railroad for transportation for R. I. Meeker.

*Utah.*—Engineer George L. Swendsen,[e] assisted by W. G. Swendsen, acting hydrographer, and A. B. Larson. Acknowledgments are due to the Oregon Short Line, Denver and Rio Grande, and San Pedro, Los Angeles and Salt Lake railroads for transportation; to the Telluride Power Company, the Spanish Fork and Payson canal companies, the Sevier River water users, and State Engineer C. Tanner; also to Doctor Hyatt, of the United States Weather Bureau, for material assistance in field observations. The Salt Lake daily papers have continued their interest by following conditions very closely. The hydrographic work in the Uinta Indian Reserve and on upper Green River in Utah has been carried on under the direction of the district hydrographer, M. C. Hinderlider, by the resident hydrographer, Howard S. Reed, with headquarters at Fort Duchesne.

*Wyoming.*—The hydrographic work in this State has been carried on under the direction of the district hydroprapher, M. C. Hinderlider, and by the resident hydrographer, A. J. Parshall. Acknowledgments are due the Union Pacific Railroad for annual passes over its lines in Wyoming for the resident hydrographer.

## GENERAL DESCRIPTION OF COLORADO RIVER DRAINAGE BASIN.

Colorado River is formed in the southeastern part of Utah by the junction of Grand and Green rivers. Green River is larger than the Grand and is the upward continuation of the Colorado. Including the Green the entire length of the Colorado is about 2,000 miles. The region drained is about 800 miles long, varies in width from 300 to 500 miles, and contains about 300,000 square miles. It comprises the southwestern part of Wyoming, the western part of Colorado, the eastern half of Utah, practically all of Arizona, and small portions of California, Nevada, New Mexico, and old Mexico. Most of this area is arid, the mean annual rainfall being about 8½ inches. The streams receive their supply from the melting snows on the high mountains of Wyoming, Utah, and Colorado.

There are two distinct portions of the basin of the Colorado. The lower third is but little above the level of the sea, though here and there ranges of mountains rise to elevations of 2,000 to 6,000 feet. This part of the valley is bounded on the north by a line of cliffs which present a bold, often vertical, step hundreds or thousands of feet, to the table-land above. The upper two-thirds of the basin stands from 4,000 to 8,000 feet above sea level, and is bordered on the east, west, and north by ranges of snow-clad mountains which attain altitudes varying from 8,000 to 14,000 feet above sea level. Through this plateau the Colorado and its tributaries have cut narrow gorges or canyons in which they flow at almost inaccessible depths. At points where lateral streams enter, the canyons are broken by narrow, transverse valleys, diversified by bordering willows, clumps of box elder, and small groves of cottonwood. The whole upper basin of the Colorado is traversed by a labyrinth of these canyons, most of which are dry during the greater portion of the year, and carry water only during the melting of the snow and the brief period of the autumnal and spring rains.

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[a] Office, Phoenix, Ariz.

[b] Office, 1108 Union Trust Building, Los Angeles, Cal.

[c] Office of district engineer for Colorado, Kansas, eastern Utah, northern New Mexico, and southern Wyoming, Chamber of Commerce Building, Denver, Colo.

[d] Office, Carson, Nev.

[e] Office, Salt Lake City, Utah.

Low mesas, dry and treeless, stretch back from the brink of the canyons, and beyond are long lines of brilliantly colored cliffs, scores or hundreds of miles in length and hundreds or thousands of feet in altitude, presenting steep or even vertical faces of rock. These cliffs form a series of terraces, and each marks the boundary "of some geological series of strata the edges of which are exposed, like courses of masonry, in the scarp walls of the palisades."[a] The lateral extension of such a line of cliffs is very irregular, sharp salients being projected on the plains below and deep recesses cut into the terraces above.

The region is further diversified by short ranges of eruptive mountains. A vast system of fissures extends across the country, and huge cinder cones, red, brown, and black, stand along the fissures and form conspicuous landmarks, set, as they are, in contrast to the bright varigated rocks of sedimentary origin.[b]

As a matter of convenience the drainage area has been divided into three basins: (1) Green River basin, (2) Grand River basin, and (3) Colorado River below the junction of Grand and Green rivers, and each of these basins is subdivided to allow the separate description of branches of the main river.

## GREEN RIVER DRAINAGE BASIN.

### AREA AND EXTENT.

Green River and its tributaries drain an area rudely triangular in outline, bounded on the north and east by the Wind River Mountains and the ranges forming the Continental Divide, on the south and east by the White River Plateau and the Roan or Book Cliffs, and on the north and west by the Gros Ventre and Wyoming mountains and the great Wasatch Range. The greatest length of the basin, north and south, is about 370 miles. In an east-west direction it measures at its widest point about 240 miles. The total drainage area is approximately 41,000 square miles.

The area includes a large part of western Wyoming, northwestern Colorado, and eastern Utah. The Uinta and Uncompahgre Indian reservations are located in this basin in northeastern Utah.

In the following account of the work of the United States Geological Survey in this region during 1905 the basin has been subdivided, as a matter of convenience, the main river being described first and the tributary streams, beginning at the headwaters, afterwards.

## GREEN RIVER.

### DESCRIPTION OF BASIN.

Green River heads on the west slope of the Wind River Mountains in western Wyoming, its ultimate source being a number of small lakes fed by the glaciers and immense snow deposits always to be found on Fremont and neighboring peaks. For perhaps 25 miles the river flows northwestward through the mountains. It then turns abruptly and runs in a general southerly direction across western Wyoming into Utah. A few miles below the Wyoming-Utah boundary another sharp turn carries the river eastward along the Uinta Mountains, through which it breaks near the east end of the range. It then flows southward in Colorado for about 25 miles, turns back into Utah, and continues to flow in a southwesterly and southerly direction until it unites with the Grand to form the Colorado. Its length, measured roughly along the course, is approximately 425 miles.

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[a] Dutton, C. E., Physical geology of the Grand Canyon district: Second Ann. Rept. U. S. Geol. Survey, 1882, p. 51.

[b] Powell, J. W., Exploration of the Colorado River of the West, Washington, 1875, p. 6.

The topography of the headwater region is rugged in the extreme. The Wind River Range on the east and the Gros Ventre and Wyoming ranges on the northwest and west gradually close in as they extend southward, forming a basin comprising approximately 7,450 square miles in extent above the gaging station at Green River, Wyo. The upper part of this basin is very narrow, but southward the valley opens out and near Fontanelle, Wyo., is several miles wide, with benches and rolling table-lands extending westward to the foothills of the Wyoming Range and eastward to the bluffs which hug the east bank of the river. At Green River the valley is again narrow—only a few hundred yards in width—and for some distance southward the river runs between bluffs standing so close together that no flood plain is seen. Throughout much of its course in Utah the Green flows through a succession of long, deep, narrow canyons, with walls ranging in height from a few hundred to as many thousand feet, separated by short valleys containing small tracts of arable lands.

In its upper course the Green receives as tributaries numerous streams heading in the Wind River, Gros Ventre, and Wyoming ranges of mountains, some of them extending so far back into the abrupt, ragged canyons that they dovetail with streams flowing in opposite directions. The most important of these tributaries are Newfork River, Big Sandy Creek, La Barge Creek, Fontanelle Creek, Black Fork, and Henry Fork. South of the Uinta Mountains the first large stream flowing into the Green is the Yampa, which comes in from the east at the point where the Green turns westward to reenter Utah after its southward journey in Colorado. Farther south Ashley Creek and Uinta and White rivers discharge their waters to the Green, Ashley Creek and the Uinta from the west and the White from the east. Below this point the only tributaries of importance are Minnie Maud Creek and San Rafael River, which enter from the west, the latter at a point about 32 miles above the junction of the Green and the Grand.

In the foothills and in close proximity to the main ranges of the upper portion of the basin the soil is sand mixed with disintegrated granite, changing into a light, sandy loam on the rolling uplands, and a rich alluvial deposit in the valleys adjacent to the waterways. Very little land is under cultivation, and except in a few favored localities the only product is hay, which is consumed by the stock grazed on the surrounding hills. Directly south of the Uinta Mountains, in the region drained by Ashley Creek and Uinta, Whiterocks, and Duchesne rivers, large tracts of excellent agricultural land are found, much of it being comprised in the Uinta Indian Reservation.

The geology of this basin is described in the Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories for 1877, F. V. Hayden in charge, pages 509-646. Information in regard to the hydrography is contained in the first to fourth annual reports of the Reclamation Service and in other United States Geological Survey reports.

## GREEN RIVER AT GREENRIVER, WYO.

This station was established May 2, 1895, near the pump house at a point about 40 feet below the bridge of the Union Pacific Railroad, at Greenriver, Wyo. Since that date it has been maintained continuously, except for a few months during the winter and during the year 1900.

The channel is straight for about 500 feet above and 300 feet below the measuring section, and the banks are sufficiently high to prevent overflow. The bed of the stream is composed of sand. During low-water periods the entire right half of the channel is a bed of clean sand, shifting more or less each year, and the stream runs in a single channel on the left; but as the water rises it extends across the two channels and under the approaches of the bridge. At the gage there are at ordinary stages two channels and at times of flood four channels, interrupted, to some extent, by open cribs four feet wide, made by spiking heavy planks to piles driven into the bed of the stream, which here is sandy but stable.

Discharge measurements are made from the iron highway bridge about one-half mile below the railway bridge, as the section under the latter is unsatisfactory for the purpose. The initial point for soundings is a deep notch cut in the railing near the end of the bridge on the left bank.

The gage, which was observed during 1905 by William Slater, is a staff securely fastened to heavy submerged cribbing on the east bank of the river. The bench mark is a cross on the third step from the bottom of the south end of the east abutment of the railroad bridge; elevation 12.48 feet above the zero of the gage. It has not changed perceptibly since so placed.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 272-273; Bull 140, p 200; WS 16, p 135; 28, p 131; 37, pp 286-287; 50, pp 366-367; 66, p 82; 85, p 75; 100, p 124; 133, p 53.

Discharge: Ann 18, iv, p 274; Bull 140, p 200; WS 16, p 135; 28, p 142; 37, p 287; 66, p 82; 85, p. 75; 133, p 54.

Discharge, monthly: Ann 18, iv, p 275; 19, iv, p 395; 20, iv, pp 378-380; 21, iv, p 302; Bull 140, p 201; WS 75, p 164; 85, p 77; 133, p 56.

Discharge, yearly: Ann 20, iv, p 58.

Gage heights: Bull 140, p 201; WS 11, p 70; 16, p 135; 28, p 134; 37, p 287; 50, p 367; 66, p 83; 85, p 76; 100, p 125; 133, p 54.

Hydrographs: Ann 18, iv, p 275; 19, iv, p 396; 20, iv, p 381; 21, iv, p 303.

Rainfall and run-off relation: Ann 20, iv, p 379.

Rating tables: Ann 18, iv, p 274; 19, iv, p 395; Bull 140, p 201; 28, p 144; 39, p 451; 66, p 173; 85, p 76; 133, p 55.

*Discharge measurements of Green River at Greenriver, Wyo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 26 | A. J. Parshall | 164 | 470 | 1.53 | 0.88 | 718 |
| April 6 | do | 163 | 470 | 1.22 | .85 | 573 |
| April 16 | do | 164 | 535 | 1.67 | 1.15 | 894 |
| April 28 | do | 170 | 644 | 2.13 | 1.70 | 1,374 |
| May 18 | do | 166 | 540 | 1.58 | 1.15 | 854 |
| May 28 | do | 234 | 907 | 2.81 | 2.35 | 2,546 |
| June 12 | do | 289 | 1,702 | 4.46 | 4.00 | 7,590 |
| June 25 | do | 284 | 1,258 | 3.71 | 3.05 | 4,666 |
| June 29 | do | 284 | 1,353 | 3.78 | 3.25 | 5,116 |
| July 25 | do | 240 | 919 | 2.60 | 2.30 | 2,392 |
| August 6 | do | 170 | 683 | 2.03 | 1.70 | 1,389 |
| August 16 | do | 166 | 621 | 1.77 | 1.40 | 1,103 |
| September 8 | do | 164 | 562 | 1.35 | 1.00 | 759 |
| September 23 | do | 159 | 495 | .90 | .55 | 445 |
| October 20 | do | 160 | 509 | .93 | .65 | 476 |

*Daily gage height, in feet, of Green River at Greenriver, Wyo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 0.8 | 1.42 | 2.65 | 3.4 | 1.95 | 1.2 | 0.7 |
| 2 | .85 | 1.45 | 2.68 | 3.3 | 1.9 | 1.2 | .75 |
| 3 | .8 | 1.55 | 2.85 | 3.32 | 1.82 | 1.2 | .8 |
| 4 | .82 | 1.72 | 3.12 | 3.22 | 1.8 | 1.2 | .78 |
| 5 | .85 | 1.8 | 3.48 | 3.08 | 1.75 | 1.25 | .75 |
| 6 | .88 | 1.78 | 3.7 | 3.02 | 1.7 | 1.28 | .72 |
| 7 | .95 | 1.7 | 3.95 | 2.95 | 1.65 | 1.22 | .7 |
| 8 | .92 | 1.68 | 3.78 | 2.88 | 1.65 | 1.2 | .7 |
| 9 | .95 | 1.58 | 3.7 | 2.82 | 1.6 | 1.15 | .65 |
| 10 | 1.05 | 1.55 | 3.95 | 2.8 | 1.58 | 1.1 | .65 |
| 11 | 1.22 | 1.5 | 4.08 | 2.72 | 1.55 | 1.02 | .65 |
| 12 | 1.25 | 1.45 | 3.95 | 2.65 | 1.5 | .92 | .6 |
| 13 | 1.2 | 1.35 | 3.72 | 2.62 | 1.45 | .82 | .6 |
| 14 | 1.15 | 1.3 | 3.48 | 2.7 | 1.45 | .75 | .6 |
| 15 | 1.15 | 1.22 | 3.65 | 2.72 | 1.45 | .72 | .6 |
| 16 | 1.15 | 1.18 | 3.9 | 2.75 | 1.38 | .7 | .6 |
| 17 | 1.2 | 1.1 | 4.0 | 2.75 | 1.32 | .65 | .6 |
| 18 | 1.2 | 1.15 | 4.0 | 2.78 | 1.28 | .65 | .6 |
| 19 | 1.2 | 1.3 | 4.28 | 2.72 | 1.2 | .65 | .58 |
| 20 | 1.25 | 1.5 | 3.95 | 2.68 | 1.15 | .6 | .55 |
| 21 | 1.28 | 1.68 | 3.6 | 2.6 | 1.2 | .6 | .55 |
| 22 | 1.3 | 1.72 | 3.25 | 2.55 | 1.2 | .55 | .55 |
| 23 | 1.28 | 1.88 | 3.05 | 2.45 | 1.2 | .55 | .55 |
| 24 | 1.28 | 1.98 | 3.0 | 2.42 | 1.2 | .55 | .55 |
| 25 | 1.35 | 2.2 | 3.02 | 2.32 | 1.25 | .5 | .55 |
| 26 | 1.42 | 2.3 | 3.1 | 2.22 | 1.2 | .5 | .52 |
| 27 | 1.52 | 2.3 | 3.15 | 2.2 | 1.2 | .5 | .5 |
| 28 | 1.58 | 2.42 | 3.22 | 2.15 | 1.15 | .55 | .5 |
| 29 | 1.6 | 2.58 | 3.32 | 2.12 | 1.2 | .58 | .5 |
| 30 | 1.55 | 2.72 | 3.4 | 2.08 | 1.2 | .62 | .55 |
| 31 | ........ | 2.75 | ........ | 2.0 | 1.2 | ........ | .55 |

*Station rating table for Green River at Greenriver, Wyo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 420 | 1.50 | 1,160 | 2.50 | 2,910 | 3.50 | 5,920 |
| .60 | 475 | 1.60 | 1,265 | 2.60 | 3,180 | 3.60 | 6,250 |
| .70 | 535 | 1.70 | 1,380 | 2.70 | 3,460 | 3.70 | 6,585 |
| .80 | 600 | 1.80 | 1,510 | 2.80 | 3,745 | 3.80 | 6,920 |
| .90 | 670 | 1.90 | 1,655 | 2.90 | 4,035 | 3.90 | 7,255 |
| 1.00 | 745 | 2.00 | 1,815 | 3.00 | 4,330 | 4.00 | 7,590 |
| 1.10 | 820 | 2.10 | 1,995 | 3.10 | 4,635 | 4.10 | 7,930 |
| 1.20 | 900 | 2.20 | 2,195 | 3.20 | 4,945 | 4.20 | 8,270 |
| 1.30 | 980 | 2.30 | 2,415 | 3.30 | 5,265 | 4.30 | 8,610 |
| 1.40 | 1,065 | 2.40 | 2,655 | 3.40 | 5,590 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1905 and is well defined.

*Estimated monthly discharge of Green River at Greenriver, Wyo., for 1905.*

[Drainage area, 7,450 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 1,265 | 600 | 883 | 52,540 | 0.119 | 0.133 |
| May | 3,602 | 820 | 1,582 | 97,270 | .212 | .244 |
| June | 8,542 | 3,320 | 5,947 | 353,900 | .798 | .890 |
| July | 5,590 | 1,815 | 3,459 | 212,700 | .464 | .535 |
| August | 1,735 | 860 | 1,122 | 68,990 | .151 | .174 |
| September | 964 | 420 | 639 | 38,020 | .086 | .096 |
| October | 600 | 420 | 486 | 29,880 | .065 | .075 |
| The period | | | | 853,300 | | |

## GREEN RIVER AT JENSEN, UTAH.

This station was established November 7, 1903. It is located at Jensen post-office, about 300 feet below what is known as Billings Ferry, 15 miles from Vernal. The nearest railroad station, Dragon, Utah, is about 40 miles distant. Brush Creek enters the river 1½ miles above the station and Ashley Creek 3 miles below.

The channel is straight for about 1,000 feet above and below the station. The right bank is high, is composed of gravel, and will not overflow; the left bank is low and sandy and covered with underbrush. The bed of the stream is sandy and shifting. There is but one channel at all stages.

The first discharge measurements were made from the ferryboat, but the station was equipped with a cable and car during 1904. The initial point for soundings is the first white mark on the cable on the right bank.

The gage is a vertical timber 10 feet long, braced to a cottonwood tree about 10 feet from the edge of the river. The gage is referred to bench marks as follows: (1) A 40-penny spike driven into the cottonwood tree to which the gage is attached; elevation, 10.66 feet above the zero of the gage. (2) A 40-penny spike driven into the southwest corner of Mr. Billings's grain house about 3 feet above the ground; elevation, 25.64 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 123–124; 133, p 56.
Discharge: 100, p 124; 133, p 57.
Discharge, monthly: 133, p 58.
Gage heights: 100, p 124; 133, p 57.
Rating table: 133, p 58.

*Daily gage height, in feet, of Green River at Jensen, Utah, for 1905.*

| Day. | June. | July. | Aug. | Day. | June. | July. | Aug. | Day. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8.9 | 6.96 | 3.86 | 12 | 11.1 | 5.28 | | 22 | 8.28 | 4.7 | |
| 2 | 9.18 | 6.79 | 3.82 | 13 | 10.88 | 5.2 | | 23 | 7.52 | 4.52 | |
| 3 | 9.59 | 6.73 | 3.68 | 14 | 10.36 | 5.09 | | 24 | 7.71 | 4.48 | |
| 4 | 9.81 | 6.64 | 3.6 | 15 | 9.98 | 4.97 | | 25 | 7.66 | 4.4 | |
| 5 | 10.15 | 6.68 | 3.48 | 16 | 9.75 | 4.92 | | 26 | 7.59 | 4.25 | |
| 6 | 10.4 | 6.49 | | 17 | 9.52 | 4.87 | | 27 | 7.4 | 4.1 | |
| 7 | 11.09 | 6.11 | | 18 | 9.49 | 4.82 | | 28 | 7.23 | 3.99 | |
| 8 | 11.16 | 5.88 | | 19 | 9.46 | 4.86 | | 29 | 7.09 | 3.93 | |
| 9 | 10.92 | 5.69 | | 20 | 9.34 | 4.86 | | 30 | 6.96 | 4.0 | |
| 10 | 10.82 | 5.47 | | 21 | 8.86 | 4.82 | | 31 | | 3.76 | |
| 11 | 10.05 | 5.39 | | | | | | | | | |

## GREEN RIVER AT OURAY, UTAH.

This station was established March 23, 1904. It is located about 500 feet below the ferry maintained by the Government at Ouray, Utah. The nearest town is Vernal, Utah, 35 miles distant, and the nearest railroad station is Dragon, about 35 miles distant.

The channel is slightly curved for about 2,000 feet above and is straight for 1,200 feet below the station. Both banks are fairly high and timbered. The right bank overflows for a short distance at high stages. The bed is composed of clean sand and is shifting. The stream is usually confined to one channel, which changes as sand bars are formed during high water. The velocity is fairly good.

Discharge measurements are made from the Government ferry cable, which is suspended across the river about 500 feet above the gage. The initial point for soundings is the first white mark on the cable on the right bank of the river.

The gage is a staff securely driven into the river bottom and spiked to a large cottonwood tree that overhangs the right bank. The gage is referred tc bench marks as follows: (1) A large nail driven into the inside face of the tree that supports the gage rod; elevation, 13.80 feet above the zero of the gage. (2) A large nail driven into a blaze on a root of one of a group of large cottonwood trees 150 feet northeast of the gage; elevation, 13.51 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 59–60.

*Daily gage height, in feet, of Green River at Ouray, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 0.8 | 1.45 | 1.15 | 4.32 | 8.45 | 5.75 |
| 2 | .5 | .8 | 1.55 | 1.1 | 4.75 | 8.75 | 5.55 |
| 3 | .5 | .82 | 1.72 | 1.1 | 5.0 | 9.25 | 5.48 |
| 4 | .5 | .88 | 1.92 | 1.0 | 5.6 | 9.72 | 5.32 |
| 5 | .5 | .95 | 2.0 | 1.0 | 5.95 | 10.1 | 5.22 |
| 6 | .5 | 1.0 | 1.9 | 1.02 | 5.4 | 10.28 | 5.05 |
| 7 | .5 | 1.0 | 1.75 | 1.1 | 4.82 | 10.72 | 4.85 |
| 8 | .5 | 1.0 | 1.5 | 1.02 | 4.45 | 11.12 | 4.42 |
| 9 | .5 | 1.0 | 1.25 | .92 | 4.25 | 11.28 | ........ |
| 10 | .5 | 1.0 | 1.1 | 1.0 | 4.1 | 10.95 | ........ |
| 11 | .55 | 1.0 | 1.0 | 1.5 | 4.22 | 10.4 | ........ |
| 12 | .65 | 1.0 | 1.0 | 1.82 | 4.4 | 10.55 | ........ |
| 13 | .7 | 1.0 | 1.0 | 2.1 | 4.7 | 10.75 | ........ |
| 14 | .7 | 1.02 | .95 | 2.3 | 4.6 | 10.22 | ........ |
| 15 | .7 | 1.08 | .9 | 2.3 | 4.28 | 9.72 | ........ |
| 16 | .7 | 1.1 | 1.0 | 2.3 | 4.0 | 9.35 | ........ |
| 17 | .7 | 1.12 | 1.05 | 2.3 | 3.95 | 8.92 | ........ |
| 18 | .7 | 1.18 | 1.2 | 3.05 | 4.05 | 8.88 | ........ |
| 19 | .7 | 1.2 | 1.32 | 3.05 | 4.45 | 8.7 | ........ |
| 20 | .7 | 1.22 | 1.38 | 3.3 | 5.65 | 8.38 | ........ |
| 21 | .7 | 1.25 | 1.4 | 2.65 | 6.55 | 8.25 | ........ |
| 22 | .7 | 1.25 | 1.42 | 2.7 | 7.22 | 8.0 | ........ |
| 23 | .7 | 1.25 | 1.48 | 2.9 | 7.72 | 7.7 | ........ |
| 24 | .7 | 1.28 | 1.5 | 2.76 | 8.3 | 7.32 | ........ |
| 25 | .7 | 1.3 | 1.5 | 2.65 | 8.78 | 6.9 | ........ |
| 26 | .7 | 1.3 | 1.48 | 2.75 | 8.95 | 6.58 | ........ |
| 27 | .7 | 1.3 | 1.38 | 3.05 | 9.1 | 6.5 | ........ |
| 28 | .7 | 1.3 | 1.28 | 3.2 | 8.9 | 6.28 | ........ |
| 29 | .7 | ........ | 1.18 | 3.3 | 8.9 | 6.1 | ........ |
| 30 | .72 | ........ | 1.1 | 3.5 | 8.72 | 5.9 | ........ |
| 31 | .78 | ........ | 1.2 | ........ | 8.52 | ........ | ........ |

### GREEN RIVER AT GREENRIVER, UTAH.

This station was established October 21, 1894, discontinued in November, 1896, and reestablished February 16, 1905. It is located at the Rio Grande Western Railway bridge at Greenriver (formerly Blake), Utah, in latitude 39° north, longitude 110° 9' west, in the San Rafael quadrangle.

The channel is straight for about 2,000 feet above and 1,000 feet below the station. Both banks are barren and are sufficiently high to prevent overflow. At the ferry cable the bed is of clay and shale and is apparently permanent except for a thin layer of silt or sand, which is deposited near the center at low stages and sluices out at high stages. The bed at the railroad bridge is in the main solid rock and is probably permanent, but is rather rough in profile. Conditions for high-water measurements are unfavorable owing to the large masonry piers of the bridge and the high velocity of the current. The velocity at the low-water section is low. Information in regard to winter conditions is incomplete.

At low and ordinary stages discharge measurements are made from a ferryboat at a point 400 to 500 feet above the bridge. The cable to which the ferryboat is attached is graduated at 20-foot intervals with white paint. The initial point for soundings is the south face of a blazed tree, to which the cable is attached, on the west side of the stream. High-water measurements are made from the lower chord on the upstream side of the steel-truss railroad bridge. The initial point for soundings is a white zero mark across the rail on the east end of the bridge.

The gage, which was read during 1905 by Frank Jacobs, is of the chain type, and is attached to the upper guard rail of the bridge at a point near the second pier from the west end. The length of the chain is 28.45 feet. The distance from the outside edge of the pulley to the 3-foot mark on the gage rod is 1.85 feet. The old bench mark established in 1894 was on a pier, but a new bridge has since been constructed and the pier changed. It was therefore impossible to get a definite tie to the original datum. A rough tie was, however, obtained from the old inclined gage on the shore near the pump house, and this showed the present datum to be 1.68 feet below the original. In view of the fact that the cross section at the gage has been changed to some extent by the relocation of the bridge piers, it is probably impossible to establish a satisfactory relation between the original records and those now being taken. The present bench mark is the top of a 1¼-inch iron drift bolt set in the west abutment of the railroad bridge on the north side. The bolt projects about 8 inches above the surface of the stone and is on one of the footing courses of the abutment about 3 feet from the top; elevation of bench mark above the zero of the gage, 25.64 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 275-276; Bull 131, p 48; 140, pp 202-203; WS 16, p 136; 28, p 131; 37, pp 292-293.

Discharge: Ann 18, iv, p 276; 19, iv, p 396; Bull 131, pp 48, 92; 140, p 202; WS 16, p 136; 37, p 293.

Discharge, monthly: Ann 18, iv, p 278; 19, iv, p 398; 20, iv, p 378, 387; 21, iv, p 304.

Discharge, yearly: Ann 20, iv, p 58.

Gage heights: Bull 140, p 203; WS 11, p 70; 16, p 136; 28, p 134; 37, p 293.

Hydrographs: Ann 18, iv, p 279; 19, iv, p 398; 20, iv, p 388; 21, iv, p 305.

Rainfall and run-off relation: Ann 20, iv, p 379.

Rating tables: Ann 18, iv, p 277; 19, iv, p 397; WS 28, p 144; 39, p 451.

*Discharge measurements of Green River at Greenriver, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 16[a] | W. G Swendsen | 450 | 1,605 | 1.95 | 4.70 | 3,129 |
| April 25[a] | do | 452 | 2,292 | 2.33 | 5.65 | 5,338 |
| April 25[a] | do | 452 | 2,292 | 2.34 | 5.65 | 5,380 |
| May 12[b] | do | 448 | 2,800 | 3.46 | 6.40 | 9,686 |
| June 2[b] | do | 474 | 3,864 | 5.76 | 8.80 | 22,270 |
| June 20[b] | do | 482 | 3,983 | 6.35 | 9.05 | 25,310 |
| August 23[a] | A. B. Larson | 438 | 1,659 | 1.31 | 4.14 | 2,175 |
| August 23[a] | do | 438 | 1,659 | 1.30 | 4.14 | 2,160 |

[a] Measurement made from ferryboat.

[b] Measurement made from railroad bridge.

*Daily gage height, in feet, of Green River at Greenriver, Utah, for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3.8 | 4.6 | 5.95 | 8.95 | 7.5 | 5.05 | 3.9 | 5.9 | 4.0 | 3.9 |
| 2 | | 3.9 | 4.75 | 6.1 | 8.8 | 7.4 | 5.0 | 3.9 | 5.2 | 4.05 | 3.8 |
| 3 | | 3.9 | 4.8 | 6.6 | 9.0 | 7.3 | 5.0 | 3.9 | 4.9 | 3.95 | 3.6 |
| 4 | | 4.05 | 4.6 | 6.85 | 9.25 | 7.25 | 5.0 | 3.9 | 4.85 | 3.85 | 3.4 |
| 5 | | 4.1 | 4.5 | 7.15 | 9.6 | 7.2 | 5.0 | 4.05 | 4.65 | 4.05 | 3.4 |
| 6 | | 4.1 | 4.5 | 7.3 | 9.8 | 7.1 | 5.0 | 4.05 | 4.6 | 4.15 | 3.3 |
| 7 | | 4.25 | 4.5 | 7.25 | 9.85 | 7.0 | 4.9 | 4.7 | 4.45 | 4.1 | 3.3 |
| 8 | | 4.5 | 4.5 | 7.0 | 10.05 | 6.9 | 4.8 | 4.45 | 4.4 | 4.1 | 3.2 |
| 9 | | 4.6 | 4.6 | 6.7 | 10.3 | 6.8 | 4.7 | 4.35 | 4.25 | 4.2 | 3.2 |
| 10 | | 4.9 | 4.5 | 6.6 | 10.55 | 6.7 | 4.7 | 4.45 | 4.3 | 4.1 | 3.2 |
| 11 | | 5.05 | 4.5 | 6.4 | 10.5 | 6.6 | 4.6 | 4.55 | 4.4 | 4.0 | 3.3 |
| 12 | | 5.0 | 4.55 | 6.4 | 10.05 | 6.45 | 4.55 | 4.55 | 4.3 | 3.95 | 3.35 |
| 13 | | 4.85 | 4.75 | 6.6 | 10.2 | 6.3 | 4.5 | 4.35 | 4.2 | 3.9 | 3.4 |
| 14 | | 4.75 | 5.0 | 6.95 | 10.2 | 6.25 | 4.5 | 4.25 | 4.25 | 3.85 | 3.4 |
| 15 | | 4.7 | 5.15 | 6.75 | 9.95 | 6.05 | 4.5 | 4.05 | 4.1 | 4.0 | 3.4 |
| 16 | 3.8 | 4.7 | 5.4 | 6.55 | 9.85 | 6.0 | 4.5 | 4.0 | 4.1 | 4.0 | 3.3 |
| 17 | 3.6 | 4.7 | 5.3 | 6.4 | 9.35 | 5.95 | 4.45 | 3.9 | 4.1 | 4.0 | 3.4 |
| 18 | 3.45 | 4.7 | 5.3 | 6.4 | 9.25 | 5.85 | 4.35 | 4.0 | 4.1 | 4.0 | 3.4 |
| 19 | 3.45 | 4.7 | 5.65 | 6.4 | 9.15 | 5.8 | 4.2 | 4.1 | 4.0 | 3.9 | 3.4 |
| 20 | 3.5 | 4.8 | 5.65 | 6.6 | 9.05 | 5.75 | 4.2 | 4.0 | 3.9 | 3.9 | 3.4 |
| 21 | 3.5 | 4.75 | 5.45 | 7.0 | 8.85 | 5.7 | 4.2 | 4.15 | 3.9 | 4.0 | 3.4 |
| 22 | 3.5 | 4.95 | 5.4 | 7.55 | 8.65 | 5.7 | 4.2 | 4.2 | 4.0 | 4.4 | 3.4 |
| 23 | 3.6 | 5.0 | 5.5 | 7.95 | 8.55 | 5.6 | 4.2 | 4.3 | 4.05 | 4.25 | 3.5 |
| 24 | 3.6 | 4.9 | 5.55 | 8.3 | 8.4 | 5.6 | 4.0 | 4.2 | 4.0 | 4.2 | 3.6 |
| 25 | 3.6 | 4.8 | 5.65 | 8.6 | 8.35 | 5.5 | 4.0 | 4.4 | 4.0 | 4.1 | 3.6 |
| 26 | 3.7 | 4.8 | 5.65 | 8.85 | 8.15 | 5.45 | 4.15 | 4.45 | 4.0 | 4.0 | 3.6 |
| 27 | 3.7 | 4.8 | 5.5 | 9.05 | 8.05 | 5.4 | 4.15 | 4.6 | 4.0 | 4.05 | 3.6 |
| 28 | 3.8 | 4.8 | 5.55 | 9.2 | 7.85 | 5.3 | 4.0 | 4.65 | 4.0 | 4.15 | 3.6 |
| 29 | | 4.8 | 5.75 | 9.05 | 7.75 | 5.25 | 4.0 | 5.15 | 4.0 | 4.1 | 3.6 |
| 30 | | 4.7 | 5.95 | 9.05 | 7.6 | 5.2 | 3.95 | 5.85 | 4.0 | 4.0 | 3.6 |
| 31 | | 4.7 | | 9.0 | | 5.2 | 3.9 | | 4.0 | | 3.6 |

NOTE.—Ice conditions December 23-31.

*Station rating table for Green River at Greenriver, Utah, from February 16, 1905, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 1,220 | 4.60 | 2,900 | 6.00 | 7,110 | 7.80 | 16,110 |
| 3.30 | 1,290 | 4.70 | 3,100 | 6.10 | 7,510 | 8.00 | 17,360 |
| 3.40 | 1,370 | 4.80 | 3,320 | 6.20 | 7,920 | 8.20 | 18,670 |
| 3.50 | 1,460 | 4.90 | 3,560 | 6.30 | 8,340 | 8.40 | 20,020 |
| 3.60 | 1,550 | 5.00 | 3,820 | 6.40 | 8,770 | 8.60 | 21,410 |
| 3.70 | 1,650 | 5.10 | 4,090 | 6.50 | 9,210 | 8.80 | 22,870 |
| 3.80 | 1,760 | 5.20 | 4,370 | 6.60 | 9,660 | 9.00 | 24,400 |
| 3.90 | 1,870 | 5.30 | 4,660 | 6.70 | 10,120 | 9.20 | 25,970 |
| 4.00 | 1,990 | 5.40 | 4,960 | 6.80 | 10,600 | 9.40 | 27,590 |
| 4.10 | 2,120 | 5.50 | 5,280 | 6.90 | 11,090 | 9.60 | 29,260 |
| 4.20 | 2,260 | 5.60 | 5,620 | 7.00 | 11,590 | 9.80 | 30,970 |
| 4.30 | 2,410 | 5.70 | 5,970 | 7.20 | 12,640 | 10.00 | 32,720 |
| 4.40 | 2,560 | 5.80 | 6,340 | 7.40 | 13,750 | 10.50 | 37,230 |
| 4.50 | 2,720 | 5.90 | 6,720 | 7.60 | 14,900 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is fairly well defined between gage heights 4.1 feet and 9.1 feet.

*Estimated monthly discharge of Green River at Greenriver, Utah, for 1905.*

[Drainage area, 38,200 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| February 16-28 | 1,760 | 1,415 | 1,556 | 40,120 | 0.041 | 0.020 |
| March | 3,955 | 1,760 | 3,020 | 185,700 | .079 | .091 |
| April | 6,915 | 2,720 | 4,256 | 253,200 | .111 | .124 |
| May | 25,970 | 6,915 | 13,910 | 855,300 | .364 | .420 |
| June | 37,700 | 14,900 | 26,380 | 1,570,000 | .691 | .771 |
| July | 14,320 | 4,370 | 8,202 | 504,300 | .215 | .248 |
| August | 3,955 | 1,870 | 2,751 | 169,200 | .072 | .083 |
| September | 6,530 | 1,870 | 2,530 | 150,600 | .066 | .074 |
| October | 6,720 | 1,870 | 2,506 | 154,100 | .066 | .076 |
| November | 2,560 | 1,815 | 2,052 | 122,100 | .054 | .060 |
| December 1-22 | 1,870 | 1,220 | 1,382 | 60,300 | .036 | .029 |
| The period | | | | 4,065,000 | | |

## NEWFORK RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Newfork River and its tributaries drain a portion of the western slopes of the Wind River Range, extending from Fremont Peak southeastward to Mount Bonneville, Mount Geikie, and Twin Buttes. The main stream flows in a general southerly course to a point near Cora, Wyo., where it turns sharply to the southwest, joining Green River about 40 miles below.

The entire length of the Newfork does not exceed 50 miles. The basin as a whole is triangular in shape and comprises approximately 1,100 square miles. Forests, in some places dense, cover about 300 square miles. Pines predominate, but aspens and firs are also found.

Pine, Pole, and Boulder creeks and Eastfork River are the chief tributaries of the Newfork. These are all small streams, heading far back among the high peaks of the range and fed by the numerous springs and small mountain lakes with which the region is dotted. Fremont, Boulder, Fayette, Half Moon, Burnt, and Meadow lakes are the largest and most important of these. Fremont Lake, through which Pine Creek flows, has an area of approximately 2,500 acres. The outlet is narrow and a dam at this point might be made to raise the water surface about 30 feet. Such a dam would probably store all the surplus waters of the creek. Boulder Creek flows through Boulder Lake. The outlet of this lake also is narrow, and a dam to raise the surface of the lake about 5 feet is in process of construction. In the drainage area of Pole Creek there are said to be no less than 40 small settling basins.

The upper portion of all these streams is forested and the valleys and rolling bench lands are covered with sagebrush and a sparse growth of nutritious grasses. The soil of the foothill region is sandy and gravelly in character, gradually becoming a rich loam at the lower levels. Several ditches are taken out of Pine and Pole creeks and Eastfork River, and small areas of land are irrigated in a primitive way. The valley of Boulder Creek contains from 15,000 to 20,000 acres of the best agricultural land in the northern Green River basin. This could easily be watered from the creek, and diversion projects which contemplate the reclamation of the greater part of it are well under way.

## NEWFORK RIVER NEAR CORA, WYO.

A temporary gaging station was established May 23, 1905, for the purpose of obtaining data in regard to the relative run-off of the stream and its tributaries. It is located at the "Pinedale Crossing," about 3 miles below Cora, in sec. 19, T. 34 N., R. 104 W.

The channel, though generally very winding, is straight for 150 feet above and 100 feet below the gage. The banks are not subject to overflow. The bed of the stream is composed of cobblestones and is permanent.

Discharge measurements are made by wading at a point 100 feet above or from a foot bridge 50 feet above the gage.

The gage was read at 5 p. m. six days each week (the Sunday reading being estimated) by J. J. Hansen, the mail carrier between Cora and Pinedale. The gage consists of a board nailed to a hewn timber, firmly braced by long poles to the left bank of the stream. The bench mark is the top of a stake driven into the ground 10 feet northeast of the gage, opposite the 3.50-foot mark on the gage

The station was discontinued August 31.

*Discharge measurements of Newfork River near Cora, Wyo., in 1905.*

| Date. | Hydrographer | Width. | Area of section. | Mean velocity. | Gage height. | Discharge |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 23 | A. J. Parshall | 25 | 19 | 1.32 | 2.10 | 25 |
| May 25 | do | 25 | 19 | .95 | 2.05 | 18 |
| June 18 | do | 35 | 48 | 3.37 | 2.50 | 162 |
| June 22 | do | 30 | 26 | 1.80 | 2.15 | 49 |
| September 20 | do | 12 | 3.2 | .62 | 1.90 | 2 |

*Daily gage height, in feet, of Newfork River near Cora, Wyo., for 1905.*

| Day. | June. | July. | Aug. | Day. | June. | July. | Aug. | Day. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.3 | 2.1 | 12 | 2.25 | 2.15 | 2.1 | 23 | 2.1 | 2.1 | 2.0 |
| 2 | 2.5 | 2.28 | 2.1 | 13 | 2.2 | 2.15 | 2.1 | 24 | 2.1 | 2.1 | 2.0 |
| 3 | 2.5 | 2.25 | 2.1 | 14 | 2.25 | 2.2 | 2.1 | 25 | 2.1 | 2.1 | 2.0 |
| 4 | 2.3 | 2.2 | 2.1 | 15 | 2.3 | 2.2 | 2.1 | 26 | 2.1 | 2.15 | 2.0 |
| 5 | 2.1 | 2.2 | 2.2 | 16 | 2.3 | 2.18 | 2.05 | 27 | 2.15 | 2.15 | 2.0 |
| 6 | 2.1 | 2.2 | 2.1 | 17 | 2.7 | 2.15 | 2.05 | 28 | 2.2 | 2.1 | 2.0 |
| 7 | 2.1 | 2.2 | 2.1 | 18 | 2.5 | 2.1 | 2.05 | 29 | 2.2 | 2.1 | 2.0 |
| 8 | 2.15 | 2.2 | 2.1 | 19 | 2.3 | 2.1 | 2.05 | 30 | 2.25 | 2.1 | 2.0 |
| 9 | 2.25 | 2.2 | 2.1 | 20 | 2.2 | 2.1 | 2.0 | 31 | | 2.1 | 2.0 |
| 10 | 2.3 | 2.2 | 2.1 | 21 | 2.2 | 2.1 | 2.0 | | | | |
| 11 | 2.28 | 2.2 | 2.1 | 22 | 2.15 | 2.1 | 2.0 | | | | |

NOTE.—Sunday gage heights estimated.

## PINE CREEK NEAR PINEDALE, WYO.

Pine Creek, designated on the eariler maps as Fremont Creek, rises on the southern face of Fremont Peak, near the top, and flows southwestward to its point of junction with Newfork River. Its length is about 25 miles. From its source to a point about 2 miles beyond Fremont Lake, through which it flows, it is a winding stream having a series of falls and rapids, almost impassable even at low water. Its drainage area comprises 130 square miles, about 60 square miles being covered with forest, more or less dense. Two diversion ditches are taken from the stream, and together these irrigate about 2,000 acres of grass land. Another canal of larger dimensions is contemplated to provide water for an additional 6,000 acres.

A gaging station was established on the stream April 25, 1904. It was located about one-fourth mile west of Pinedale, but this location not proving entirely satisfactory, it was abandoned at the close of the season, and April 2, 1905, it was reestablished near the Hansen ranch, 1 mile above Pinedale, in sec. 28, T. 34 N., R. 109 W.

The channel is comparatively straight for several hundred feet above and below the gage. The stream runs high in its banks, but does not overflow. The bed is rocky and permanent. There is but one channel, and this is unobstructed except during the winter months, when ice forms. The range of gage heights seldom exceeds 2 feet.

High-water measurements are made by means of a boat, a strong wire being stretched from bank to bank for use as an anchor. During low-water periods measurements are made by wading at a point 300 yards below the gage, where the bed of the channel is generally smoother.

The gage, which during 1905 was read daily by J. J. Hansen, is a vertical 10-inch round timber, set 1 foot deep into the rocky bottom of the channel and braced firmly to a large pine tree on the right bank. The bench mark is a spike driven into the tree opposite the 5-foot mark on the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 60–62.

*Discharge measurements of Pine Creek near Pinedale, Wyo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 29 | A. J. Parshall | 26 | 25 | 1.04 | 1.00 | 26 |
| April 2 | do | 25 | 25 | 1.04 | 1.00 | 26 |
| April 21 | do | 35 | 28 | 1.29 | 1.10 | 36 |
| April 24 | do | 28 | 32 | 1.09 | 1.10 | 35 |
| May 23 | do | 77 | 80 | 1.50 | 1.40 | 120 |
| May 23[a] | do | 35 | 52 | 2.04 | 1.40 | 106 |
| May 25 | do | 77 | 87 | 1.58 | 1.45 | 137 |
| May 30 | G. N. Stadin | 78 | 118 | 2.07 | 1.65 | 244 |
| June 18[b] | A. J. Parshall | 80 | 204 | 6.19 | 2.85 | 1,262 |
| June 22[b] | do | 80 | 180 | 4.88 | 2.50 | 878 |
| August 11 | do | 80 | 116 | 2.31 | 1.70 | 268 |
| September 16 | do | 30 | 34 | 2.26 | 1.30 | 77 |
| September 20 | do | 30 | 31 | 2.16 | 1.25 | 67 |

[a] Measured at a point 300 yards below station, below a diversion ditch.
[b] Measurements made from boat.

*Daily gage height, in feet, of Pine Creek near Pinedale, Wyo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 1.15 | 1.7 | 2.8 | 2.0 | 1.45 | 1.2 |
| 2 | 1.0 | 1.15 | 1.8 | 2.8 | 1.9 | 1.45 | 1.2 |
| 3 | 1.0 | 1.2 | 1.9 | 2.8 | 1.9 | 1.45 | 1.2 |
| 4 | 1.0 | 1.2 | 2.0 | 2.8 | 1.85 | 1.45 | 1.25 |
| 5 | 1.0 | 1.2 | 2.2 | 2.75 | 1.8 | 1.4 | 1.2 |
| 6 | 1.0 | 1.2 | 2.35 | 2.75 | 1.8 | 1.4 | 1.2 |
| 7 | 1.0 | 1.2 | 2.4 | 2.7 | 1.8 | 1.4 | 1.2 |
| 8 | 1.0 | 1.2 | 2.5 | 2.7 | 1.8 | 1.4 | 1.2 |
| 9 | 1.0 | 1.2 | 2.6 | 2.7 | 1.75 | 1.4 | 1.2 |
| 10 | 1.0 | 1.2 | 2.7 | 2.7 | 1.75 | 1.4 | 1.2 |
| 11 | 1.0 | 1.2 | 2.7 | 2.7 | 1.7 | 1.4 | 1.2 |
| 12 | 1.0 | 1.2 | 2.6 | 2.7 | 1.7 | 1.4 | 1.2 |
| 13 | 1.0 | 1.25 | 2.7 | 2.65 | 1.65 | 1.4 | 1.15 |
| 14 | 1.0 | 1.25 | 2.8 | 2.6 | 1.6 | 1.35 | 1.15 |
| 15 | 1.0 | 1.2 | 2.8 | 2.6 | 1.6 | 1.35 | 1.15 |
| 16 | 1.0 | 1.2 | 2.8 | 2.6 | 1.6 | 1.35 | 1.15 |
| 17 | 1.0 | 1.2 | 2.9 | 2.6 | 1.6 | 1.35 | 1.15 |
| 18 | 1.1 | 1.25 | 2.9 | 2.6 | 1.6 | 1.3 | 1.15 |
| 19 | 1.05 | 1.25 | 2.8 | 2.6 | 1.55 | 1.3 | 1.15 |
| 20 | 1.05 | 1.3 | 2.7 | 2.4 | 1.55 | 1.3 | 1.15 |
| 21 | 1.1 | 1.3 | 2.6 | 2.35 | 1.55 | 1.25 | 1.15 |
| 22 | 1.1 | 1.3 | 2.5 | 2.35 | 1.5 | 1.25 | 1.1 |
| 23 | 1.1 | 1.4 | 2.5 | 2.3 | 1.5 | 1.25 | 1.1 |
| 24 | 1.1 | 1.4 | 2.5 | 2.3 | 1.5 | 1.25 | 1.1 |
| 25 | 1.1 | 1.5 | 2.5 | 2.2 | 1.5 | 1.25 | 1.1 |
| 26 | 1.1 | 1.5 | 2.5 | 2.15 | 1.5 | 1.25 | 1.1 |
| 27 | 1.1 | 1.55 | 2.6 | 2.15 | 1.5 | 1.25 | 1.1 |
| 28 | 1.1 | 1.6 | 2.7 | 2.1 | 1.5 | 1.25 | 1.1 |
| 29 | 1.1 | 1.6 | 2.7 | 2.1 | 1.5 | 1.2 | 1.1 |
| 30 | 1.1 | 1.7 | 2.8 | 2.1 | 1.5 | 1.2 | 1.1 |
| 31 | | 1.7 | | 2.0 | 1.5 | | 1.1 |

*Station rating table for Pine Creek near Pinedale, Wyo., from March 29 to September 20, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 26 | 1.60 | 206 | 2.20 | 607 | 2.80 | 1,200 |
| 1.10 | 35 | 1.70 | 258 | 2.30 | 694 | 2.90 | 1,313 |
| 1.20 | 54 | 1.80 | 316 | 2.40 | 786 | 3.00 | 1,430 |
| 1.30 | 83 | 1.90 | 380 | 2.50 | 885 | | |
| 1.40 | 118 | 2.00 | 451 | 2.60 | 986 | | |
| 1.50 | 159 | 2.10 | 526 | 2.70 | 1,091 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made from March 29 to September 20, 1905, and is well defined.

*Estimated monthly discharge of Pine Creek near Pinedale, Wyo.*

[Drainage area, 130 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 35 | 26 | 29.6 | 1,761 | 0.228 | 0.254 |
| May | 258 | 43 | 95.8 | 5,890 | .737 | .850 |
| June | 1,313 | 258 | 932 | 55,460 | 7.17 | 8.00 |
| July | 1,200 | 451 | 904 | 55,580 | 6.95 | 8.01 |
| August | 451 | 159 | 236 | 14,510 | 1.82 | 2.10 |
| September | 138 | 54 | 96.9 | 5,766 | .745 | .831 |
| October | 67 | 35 | 45.1 | 2,773 | .347 | .400 |
| The period | | | | 141,700 | | |

## POLE CREEK AT FAYETTE, WYO.

Pole Creek rises on the southern and western slopes of Newfork Peak, flows southwestward, and unites with Newfork River about midway between the points where Pine Creek and Eastfork River join that stream. Like the other tributaries of the Newfork, it is a mountain stream, its source of supply being the direct drainage at its head and numerous small lakes and ponds, of which Fayette and Halfmoon lakes are the largest. The creek is about 25 miles in length. For the last 10 miles of its course it flows through a level or slightly undulating valley, varying from 1 mile to 3 miles in width, with a rich alluvial soil. Two diversion ditches, which provide water for the irrigation of about 3,700 acres of land, are taken from the creek.

The gaging station was established April 22, 1904. It is located at a point opposite and about 300 yards distant from Fayette post-office, in sec. 9, T. 33 N., R. 108 W.

The channel is straight for about 50 feet above and 100 feet below the station. The right bank is low, is covered with brush, and is liable to overflow. The left bank is high and clean and does not overflow. The bed is composed of cobblestones and sand and is stable. There is but one channel at low water; at high water there is one main channel and a small slough on each side. The slope of the channel is toward the left bank, and the current is swift. Gage heights have a range of nearly 3 feet. The creek seldom freezes entirely over owing to the velocity of the current and the numerous adjacent springs. There are no natural obstructions except such as are formed by the accumulations of ice among the willows that fringe the banks and extend back for a considerable distance.

At ordinary stages discharge measurements are made by wading at a point about 200 yards below the gage. High-water measurements are made by means of a boat swinging from a wire stretched taut directly across the channel from bank to bank.

The gage, which was read during 1905 by G. N. Stadin, is a vertical timber set 1 foot deep into the cobblestone bed of the stream and firmly braced to the left bank. For use during high-water stages a wire gage has been attached to the vertical gage in such a way as to extend about 3 feet out over the stream. The gage is referred to bench marks as follows: (1) The top of a 3-inch stake driven firmly into the ground about 10 feet from the gage and marked with a copper number "0;" elevation above the zero of the gage, 4.47 feet. (2) The top of a similar stake about 10 feet from the gage, marked with a copper number "7;" elevation, 5.02 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 62-65.

*Discharge measurements of Pole Creek at Fayette, Wyo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 30 | A. J. Parshall | 31 | 24 | 0.79 | 1.00 | 19 |
| April 21 | do | 35 | 29 | .97 | 1.10 | 28 |
| April 25 | do | 37 | 33 | 1.03 | 1.15 | 34 |
| May 19 | G. N. Studin | 42 | 47 | 2.00 | 1.55 | 94 |
| May 21 | A. J. Parshall | 65 | 50 | 2.05 | 1.65 | 101 |
| May 23 | do | 70 | 71 | 2.72 | 2.00 | 193 |
| May 24 | do | 70 | 85 | 2.93 | 2.15 | 249 |
| May 25 | do | 70 | 94 | 3.01 | 2.25 | 283 |
| May 30 | G. N. Studin | 70 | 101 | 3.43 | 2.50 | 346 |
| June 15[a] | A. J Parshall | 70 | 155 | 5.13 | 3.00 | 795 |
| June 16[a] | do | 70 | 156 | 5.29 | 3.05 | 826 |
| June 17[a] | do | 70 | 163 | 5.58 | 3.15 | 910 |
| June 20[a] | do | 70 | 131 | 4.50 | 2.80 | 590 |
| June 21[a] | do | 70 | 122 | 4.18 | 2.70 | 510 |
| June 22[a] | do | 70 | 114 | 3.98 | 2.65 | 454 |
| August 9 | do | 44 | 49 | 1.88 | 1.60 | 92 |
| August 13 | do | 43 | 47 | 1.79 | 1.55 | 84 |
| September 17 | do | 35 | 29 | .96 | 1.12 | 28 |
| September 19 | do | 35 | 28 | .93 | 1.10 | 26 |

[a] Discharge measurement made from boat.

*Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1905.*

| Day. | Apr. | May | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 1.25 | 2.45 | 2.85 | 1.85 | 1.3 | 1.0 |
| 2 | 1.0 | 1.30 | 2.55 | 2.85 | 1.85 | 1.3 | 1.0 |
| 3 | 1.0 | 1.4 | 2.55 | 2.7 | 1.85 | 1.3 | 1.0 |
| 4 | 1.0 | 1.4 | 2.7 | 2.7 | 1.85 | 1.3 | 1.0 |
| 5 | 1.0 | 1.4 | 2.9 | 2.6 | 1.85 | 1.3 | 1.0 |
| 6 | 1.0 | 1.4 | 2.1 | 2.6 | 1.8 | 1.3 | .95 |
| 7 | 1.0 | 1.4 | 3.1 | 2.55 | 1.75 | 1.25 | .95 |
| 8 | 1.0 | 1.4 | 3.2 | 2.55 | 1.7 | 1.25 | 1.0 |
| 9 | 1.0 | 1.4 | 3.15 | 2.45 | 1.7 | 1.25 | 1.0 |
| 10 | 1.0 | 1.45 | 3.2 | 2.4 | 1.65 | 1.25 | 1.0 |
| 11 | 1.0 | 1.45 | 3.3 | 2.4 | 1.6 | 1.25 | 1.0 |
| 12 | 1.0 | 1.45 | 3.2 | 2.4 | 1.6 | 1.2 | 1.0 |
| 13 | 1.0 | 1.45 | 3.0 | 2.4 | 1.6 | 1.2 | 1.0 |

*Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 14 | 1.05 | 1.45 | 2.85 | 2.4 | 1.6 | 1.2 | 1.0 |
| 15 | 1.05 | 1.45 | 3.0 | 2.4 | 1.6 | 1.15 | 1.0 |
| 16 | 1.05 | 1.45 | 3.0 | 2.4 | 1.5 | 1.15 | .95 |
| 17 | 1.05 | 1.45 | 3.05 | 2.35 | 1.5 | 1.15 | .95 |
| 18 | 1.1 | 1.45 | 3.1 | 2.3 | 1.5 | 1.1 | .95 |
| 19 | 1.1 | 1.5 | 3.0 | 2.25 | 1.5 | 1.05 | .95 |
| 20 | 1.1 | 1.55 | 2.85 | 2.25 | 1.5 | 1.05 | .95 |
| 21 | 1.1 | 1.5 | 2.7 | 2.15 | 1.5 | 1.05 | .95 |
| 22 | 1.05 | 1.8 | 2.65 | 2.1 | 1.4 | 1.05 | .95 |
| 23 | .95 | 2.0 | 2.65 | 2.05 | 1.4 | 1.05 | .95 |
| 24 | 1.15 | 2.15 | 2.65 | 2.0 | 1.4 | 1.05 | .95 |
| 25 | 1.15 | 2.25 | 2.65 | 2.0 | 1.4 | 1.05 | .95 |
| 26 | 1.15 | 2.25 | 2.75 | 2.0 | 1.35 | 1.05 | .95 |
| 27 | 1.15 | 2.35 | 2.85 | 1.95 | 1.35 | 1.0 | .95 |
| 28 | 1.15 | 2.35 | 2.9 | 1.9 | 1.35 | 1.0 | .95 |
| 29 | 1.15 | 2.35 | 2.85 | 1.9 | 1.35 | 1.0 | .95 |
| 30 | 1.20 | 2.4 | 2.9 | 1.85 | 1.35 | 1.0 | .95 |
| 31 | ........ | 2.45 | ........ | 1.8 | 1.35 | ........ | .95 |

*Station rating table for Pole Creek at Fayette, Wyo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 19 | 1.60 | 94 | 2.20 | 255 | 2.80 | 590 |
| 1.10 | 27 | 1.70 | 114 | 2.30 | 293 | 2.90 | 680 |
| 1.20 | 36 | 1.80 | 137 | 2.40 | 335 | 3.00 | 775 |
| 1.30 | 47 | 1.90 | 162 | 2.50 | 383 | 3.10 | 875 |
| 1.40 | 60 | 2.00 | 190 | 2.60 | 440 | 3.20 | 980 |
| 1.50 | 76 | 2.10 | 221 | 2.70 | 510 | 3.30 | 1,085 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 19 discharge measurements made during 1905. It is well defined between gage heights 1 foot and 3.2 feet.

*Estimated monthly discharge of Pole Creek at Fayette, Wyo., for 1905.*

[Drainage area, 126 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 36 | 16 | 23.8 | 1,416 | 0.189 | 0.211 |
| May | 359 | 42 | 132 | 8,116 | 1.05 | 1.21 |
| June | 1,085 | 221 | 669 | 39,810 | 5.31 | 5.92 |
| July | 635 | 137 | 319 | 19,620 | 2.53 | 2.92 |
| August | 150 | 54 | 91.5 | 5,626 | .726 | .837 |
| September | 47 | 19 | 32.8 | 1,952 | .260 | .290 |
| October | 19 | 16 | 17.3 | 1,064 | .137 | .158 |
| The period | | | | 77,600 | | |

## FALL CREEK NEAR FAYETTE, WYO.

Fall Creek, a small tributary of Pole Creek, joins the latter less than 2 miles from the point where it emerges from the foothills. It is fed by numerous springs and small mountain lakes and flows through Burnt Lake, which covers an area of 700 or 800 acres. The creek is about 15 miles long and drains an area of 60 square miles, of which almost one-third is forested. The entire basin is very rough. One small ditch is taken from it, conveying water upon the Pole Creek flats.

A gaging station was established April 22, 1904. It is located about 1 mile southeast of Fayette post-office, at the crossing of the Upper Boulder road, in sec. 10, T. 33 N., R. 108 W.

The channel is straight for about 40 feet above and 50 feet below the station. The banks are high and are not liable to overflow. The bed of the stream is composed of cobblestones and gravel and is smooth. The current is swift except at very low water, when it becomes sluggish. There is but one channel at all stages. Early in 1905 some large cobblestones, which at low water protruded from the riffles below the gage, were removed, and the rating curve for 1905 is therefore slightly different from that for 1904. Gage heights have a range of almost 2 feet. The stream is frozen solid during the winter months.

Discharge measurements are made at low and ordinary stages by wading, and at high water by means of a boat, the initial point for soundings being the left bank at the gage. At extreme low water a section 200 yards below the gage is chosen.

The gage, which was read during 1905 by G. N. Stadin, is a vertical timber set in the bed of the stream and firmly braced to the left bank. The bench mark is a cross on the highest point of a stone about 1 foot in diameter planted firmly in the ground 10 feet from the gage and surrounded by smaller stones. Elevation above the zero of the gage, 4.63 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 65–67.

*Discharge measurements of Fall Creek near Fayette, Wyo., in 1905.*

| Date. | Hydrographer | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft* |
| April 21 | A. J. Parshall | 31 | 19 | 0.74 | 1.35 | 14 |
| April 25 | do | 30 | 22 | .64 | 1.35 | 14 |
| May 21 | do | 34 | 27 | 1.30 | 1.55 | 35 |
| May 23 | do | 35 | 38 | 1.90 | 1.73 | 72 |
| May 24 | do | 35 | 39 | 2.05 | 1.80 | 80 |
| May 30 | G. N. Stadin | 37 | 47 | 2.83 | 2.00 | 133 |
| June 16 | A. J. Parshall | 37 | 72 | 4.53 | 2.70 | 326 |
| June 19 | do | 37 | 62 | 3.61 | 2.35 | 224 |
| Do | do | 55 | 60 | 3.50 | 2.35 | 210 |
| June 20 | do | 37 | 55 | 3.27 | 2.15 | 180 |
| August 9 | do | 33 | 26 | 1.04 | 1.48 | 27 |
| August 13 | do | 33 | 24 | .87 | 1.42 | 21 |
| September 17 | do | 12 | 4.2 | .86 | 1.18 | 3.6 |
| September 19 | do | 12 | 4.8 | .69 | 1.15 | 3.3 |

*Daily gage height, in feet, of Fall Creek near Fayette, Wyo., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 2.1 | 2.85 | 1.6 | 1.3 | 1.15 | 17 | 1.4 | 2.7 | 1.95 | 1.4 | 1.2 | 1.15 |
| 2 | 1.4 | 2.2 | 2.85 | 1.6 | 1.3 | 1.15 | 18 | 1.45 | 2.65 | 1.9 | 1.4 | 1.15 | 1.15 |
| 3 | 1.4 | 2.4 | 2.7 | 1.6 | 1.3 | 1.15 | 19 | 1.45 | 2.3 | 1.9 | 1.4 | 1.15 | 1.15 |
| 4 | 1.4 | 2.6 | 2.4 | 1.6 | 1.3 | 1.15 | 20 | 1.5 | 2.2 | 1.9 | 1.4 | 1.15 | 1.15 |
| 5 | 1.4 | 2.7 | 2.25 | 1.6 | 1.3 | 1.15 | 21 | 1.5 | 2.25 | 1.85 | 1.35 | 1.15 | 1.15 |
| 6 | 1.4 | 2.8 | 2.15 | 1.6 | 1.25 | 1.15 | 22 | 1.65 | 2.15 | 1.8 | 1.35 | 1.15 | 1.15 |
| 7 | 1.4 | 2.75 | 2.1 | 1.55 | 1.25 | 1.15 | 23 | 1.75 | 2.2 | 1.7 | 1.35 | 1.15 | 1.15 |
| 8 | 1.4 | 2.7 | 2.0 | 1.55 | 1.25 | 1.1 | 24 | 1.8 | 2.2 | 1.7 | 1.35 | 1.15 | 1.15 |
| 9 | 1.4 | 2.85 | 1.9 | 1.5 | 1.25 | 1.1 | 25 | 1.8 | 2.2 | 1.7 | 1.3 | 1.15 | 1.15 |
| 10 | 1.4 | 2.9 | 1.95 | 1.5 | 1.25 | 1.1 | 26 | 1.9 | 2.4 | 1.6 | 1.3 | 1.1 | 1.15 |
| 11 | 1.4 | 2.5 | 1.95 | 1.45 | 1.25 | 1.1 | 27 | 2.0 | 2.45 | 1.6 | 1.3 | 1.1 | 1.15 |
| 12 | 1.4 | 2.5 | 1.95 | 1.45 | 1.25 | 1.1 | 28 | 2.0 | 2.3 | 1.6 | 1.3 | 1.1 | 1.15 |
| 13 | 1.4 | 2.4 | 1.95 | 1.4 | 1.25 | 1.1 | 29 | 2.1 | 2.3 | 1.65 | 1.3 | 1.1 | 1.15 |
| 14 | 1.4 | 2.4 | 1.95 | 1.4 | 1.2 | 1.1 | 30 | 2.1 | 2.3 | 1.65 | 1.3 | 1.1 | 1.15 |
| 15 | 1.4 | 2.5 | 1.95 | 1.4 | 1.2 | 1.15 | 31 | 2.1 | ...... | 1.65 | 1.3 | ...... | 1.15 |
| 16 | 1.4 | 2.65 | 1.95 | 1.4 | 1.2 | 1.15 | | | | | | | |

*Station rating table for Fall Creek near Fayette, Wyo., from May 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 2 | 1.60 | 46 | 2.10 | 157 | 2.60 | 293 |
| 1.20 | 5 | 1.70 | 65 | 2.20 | 183 | 2.70 | 321 |
| 1.30 | 10 | 1.80 | 86 | 2.30 | 209 | 2.80 | 350 |
| 1.40 | 18 | 1.90 | 108 | 2.40 | 237 | 2.90 | 380 |
| 1.50 | 31 | 2.00 | 132 | 2.50 | 265 | 3.00 | 410 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 14 discharge measurements made from April 21 to September 19, 1905.

*Estimated monthly discharge of Fall Creek near Fayette, Wyo., for 1905.*

[Drainage area, 60 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May | 157 | 18 | 50.4 | 3,099 | 0.840 | 0.968 |
| June | 380 | 157 | 252 | 15,000 | 4.20 | 4.69 |
| July | 365 | 46 | 130 | 7,993 | 2.17 | 2.50 |
| August | 46 | 10 | 23.5 | 1,445 | .392 | .452 |
| September | 10 | 2 | 5.33 | 317 | .089 | .099 |
| October | 3 | 2 | 2.77 | 170 | .046 | .053 |
| The period | ............ | ............ | .......... | 28,020 | ............ | ............ |

## BOULDER CREEK NEAR BOULDER, WYO.

Boulder Creek rises in the vicinity of Mounts Bonneville and Geikie, in the Wind River Mountains, flows westward through Boulder Lake, then turns to the southwest and unites with Newfork River 3 miles above the point where the latter stream is joined by the Eastfork. Numerous small mountain lakes, scattered over an area 5 or 6 miles square, contribute their drainage to the creek near its head. Boulder Lake, the largest of these, lies at an elevation of 7,200 feet and its water surface is estimated to cover 1,500 acres. The total area of the basin is 160 square miles and approximately one-third of this is timbered. The upper two-thirds of the basin is very rough; but the lower third is a gently sloping flat, which contains 15,000 to 20,000 acres of excellent agricultural land.

The gaging station was established April 23, 1904. It is located at the Coolidge ranch, about 1½ miles northeast of Boulder post-office, in sec. 4, T. 32 N., R. 108 W., and is below all diversion ditches. In the 1904 Progress Report this station was given as Boulder Creek near Newfork, Wyo.

The channel is nearly straight for about 300 feet above and below the station. The right bank is low and is covered with brush and small trees, but is liable to overflow for a short distance only; the left bank is high and can not overflow. The bed of the stream is composed of cobblestones and sand and is stable. There is but one channel at all stages, and this slopes toward the left bank. The current is swift at high water, but becomes sluggish at low stages. Gage heights have a range of about 4 feet. The stream freezes solid during the winter months. Early in 1905 the larger rocks and some sunken driftwood opposite the gage were removed, slightly changing the cross section and the value of the gage heights on the discharge curve.

Discharge measurements are made by wading at the station until the water rises to about the 2-foot mark on the gage, when the wooden highway bridge, 2 miles below, is used. The initial point for soundings is at the gage.

The gage, which was read during 1905 by T. J. Coolidge, is a timber firmly set in the bed of the stream and braced to a tree and stump on the left bank. The bench mark is a spike driven in a stump opposite the 4-foot mark on the gage and 3 feet distant.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 67-69.

*Discharge measurements of Boulder Creek near Boulder, Wyo.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 22[a] | A. J. Parshall | 25 | 25 | 1.56 | 0.50 | 39 |
| May 22 | do | 64 | 122 | 1.76 | 1.10 | 215 |
| May 24 | do | 67 | 155 | 2.51 | 1.60 | 389 |
| May 24[b] | do | 57 | 161 | 2.45 | 1.60 | 394 |
| May 28[b] | G. N. Stadin | 60 | 191 | 2.79 | 1.90 | 533 |
| June 16[b] | A. J. Parshall | 81 | 331 | 5.33 | 3.90 | 1,763 |
| June 19[b] | do | 81 | 300 | 3.37 | 2.80 | 1,011 |
| June 21[b] | do | 80 | 268 | 2.99 | 2.40 | 800 |
| June 24[b] | G. N. Stadin | 81 | 301 | 3.89 | 3.00 | 1,172 |
| August 10 | A. J. Parshall | 60 | 94 | .98 | .75 | 92 |
| August 12 | do | 60 | 86 | .86 | .70 | 74 |
| September 18 | do | 55 | 46 | .39 | .30 | 18 |

[a] Measured at point 100 yards above station. [b] Measured at bridge 2 miles below station.

*Daily gage height, in feet, of Boulder Creek near Boulder, Wyo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | | 0.5 | 2.15 | 3.0 | 0.92 | 0.45 | 0.2 |
| 2 | | .5 | 2.6 | 3.0 | .9 | .45 | .2 |
| 3 | | .6 | 2.98 | 2.78 | .88 | .45 | .2 |
| 4 | | .6 | 3.42 | 2.4 | .82 | .45 | .2 |
| 5 | | .6 | 3.92 | 2.4 | .8 | .45 | .2 |
| 6 | | .6 | 3.72 | 2.4 | .8 | .45 | .2 |
| 7 | | .6 | 3.55 | 2.38 | .8 | .42 | .2 |
| 8 | | .6 | 3.85 | 2.3 | .78 | .42 | .2 |
| 9 | | .6 | 4.15 | 2.3 | .72 | .4 | .2 |
| 10 | | .6 | 3.95 | 2.18 | .7 | .4 | .2 |
| 11 | | .6 | 3.35 | 2.12 | .7 | .4 | .2 |
| 12 | | .6 | 3.08 | 2.05 | .7 | .4 | .2 |
| 13 | | .6 | 3.25 | 2.02 | .7 | .4 | .2 |
| 14 | | .6 | 3.72 | 1.95 | .65 | .4 | .2 |
| 15 | 0.5 | .6 | 3.95 | 1.95 | .6 | .4 | .2 |
| 16 | .5 | .6 | 3.88 | 1.95 | .6 | .4 | .2 |
| 17 | .5 | .65 | 3.65 | 1.98 | .6 | .38 | .2 |
| 18 | .5 | .72 | 3.25 | 1.85 | .58 | .3 | .2 |
| 19 | .5 | .82 | 2.85 | 1.65 | .55 | .3 | .2 |
| 20 | .5 | .92 | 2.45 | 1.5 | .5 | .3 | .2 |
| 21 | .5 | 1.0 | 2.40 | 1.5 | .5 | .28 | .2 |
| 22 | .5 | 1.1 | 2.55 | 1.45 | .48 | .25 | .2 |
| 23 | .5 | 1.3 | 2.8 | 1.38 | .45 | .25 | .2 |
| 24 | .5 | 1.6 | 3.08 | 1.3 | .45 | .25 | .2 |
| 25 | .5 | 1.68 | 3.2 | 1.25 | .45 | .25 | .2 |
| 26 | .5 | 1.75 | 3.22 | 1.2 | .45 | .25 | .2 |
| 27 | .5 | 1.8 | 3.35 | 1.2 | .45 | .25 | .2 |
| 28 | .5 | 1.9 | 3.42 | 1.18 | .45 | .22 | .2 |
| 29 | .5 | 1.9 | 3.4 | 1.12 | .5 | .2 | .2 |
| 30 | .5 | 1.9 | 3.15 | 1.02 | .5 | .2 | .2 |
| 31 | | 1.85 | | 1.0 | .5 | | .2 |

*Station rating table for Boulder Creek near Boulder, Wyo., from April 15, to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.20 | 9 | 1.10 | 189 | 2.00 | 594 | 2.90 | 1,097 |
| .30 | 18 | 1.20 | 224 | 2.10 | 644 | 3.00 | 1,160 |
| .40 | 29 | 1.30 | 263 | 2.20 | 695 | 3.20 | 1,289 |
| .50 | 42 | 1.40 | 304 | 2.30 | 747 | 3.40 | 1,421 |
| .60 | 58 | 1.50 | 349 | 2.40 | 800 | 3.60 | 1,557 |
| .70 | 77 | 1.60 | 396 | 2.50 | 855 | 3.80 | 1,695 |
| .80 | 100 | 1.70 | 444 | 2.60 | 913 | 4.00 | 1,835 |
| .90 | 127 | 1.80 | 494 | 2.70 | 973 | 4.20 | 1,975 |
| 1.00 | 157 | 1.90 | 544 | 2.80 | 1,035 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0.5 foot and 3 feet.

*Estimated monthly discharge of Boulder Creek near Boulder, Wyo., for 1905.*

[Drainage area, 155 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April 15–31 | 42 | 42 | 42 | 1,333 | 0.271 | 0.161 |
| May | 544 | 42 | 188 | 11,560 | 1.21 | 1.40 |
| June | 1,940 | 913 | 1,350 | 80,330 | 8.71 | 9.72 |
| July | 1,160 | 157 | 543 | 33,390 | 3.50 | 4.04 |
| August | 133 | 35 | 64.5 | 3,966 | .416 | .480 |
| September | 35 | 9 | 23.6 | 1,404 | .152 | .170 |
| October | 9 | 9 | 9.0 | 553 | .058 | .067 |
| The period | | | | 132,500 | | |

## EASTFORK RIVER AT NEWFORK, WYO.

Eastfork River, the southernmost as well as the largest of the tributaries of the Newfork, is formed by the three small creeks which drain its upper basin. Two of these, Silver and Willow creeks, head among the small mountain lakes about Twin Butte and on the southern slopes of Mount Geikie, at an elevation of about 9,000 feet; the third, Muddy Creek, is a spring stream and heads at a somewhat lower elevation farther to the south. The total area of the Eastfork basin is about 320 square miles, and perhaps 2 per cent of this is forested. The upper portion of the basin is the broken, rugged country of the mountains; farther down the valley opens out into broad, level stretches, with a gradual slope to the west. The soil is a sandy loam, well covered in its natural condition with a heavy growth of sagebrush and a smaller quantity of nutritious grasses. Irrigation is practiced in a primitive way, a few small diversion ditches taking water out upon lowland meadows.

A gaging station was established April 1, 1905. It is located at a point about one-third mile southeast of Newfork post-office, in sec. 34, T. 32 N., R. 108 W., and about one-fourth mile above the county highway bridge across Eastfork, near the Noble ranch house.

There is but one channel and the banks are not liable to overflow. The bed of the stream is sandy and shifting, and the section is less satisfactory than was supposed when the gage was installed. Gage heights have a range of about 4 feet. The bed at the highway bridge is less changeable and furnishes a better section than that first selected, though it is divided into three channels by the piling. The river freezes solid during the later months of the winter.

During the lower stages discharge measurements are made by wading at the station, the initial point for soundings being the bench mark. At high water, when the gage reads above 2.5 feet, measurements are made from the highway bridge, which is a three-span wooden structure, resting upon piling protected by rock at the bottom.

The gage, which during 1905 was read daily by Mrs. Cora Noble, is a vertical timber, firmly braced to the right bank. The bench mark is a copper "0" on the top of a post set in the ground 10 feet west of the gage; elevation, 5.68 feet above the zero of the gage.

*Discharge measurements of Eastfork River at Newfork, Wyo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft* |
| April 22 | A. J. Parshall | 81 | 64 | 0.69 | 0.30 | 44 |
| May 22 | do | 95 | 228 | 2.18 | 1.92 | 498 |
| Do | do | 95 | 246 | 2.35 | 2.13 | 577 |
| May 24[a] | do | 75 | 238 | 2.84 | 2.40 | 675 |
| May 28[a] | G. N. Stadin | 75 | 274 | 3.31 | 2.65 | 907 |
| June 16[a] | A. J. Parshall | 75 | 324 | 4.26 | 3.35 | 1,381 |
| June 19[a] | do | 75 | 259 | 2.97 | 2.50 | 769 |
| June 21[a] | do | 75 | 215 | 2.40 | 2.00 | 516 |
| June 24[a] | G. N. Stadin | 75 | 272 | 2.84 | 2.45 | 772 |
| August 10 | A. J. Parshall | 85 | 80 | .67 | .40 | 54 |
| August 12 | do | 83 | 71 | .68 | .35 | 48 |
| September 18[b] | do | 64 | 54 | .63 | .20 | 34 |

[a] Discharge measurement made at bridge below station.
[b] Discharge measurement made 100 yards below station.

*Daily gage height, in feet, of Eastfork River at Newfork, Wyo., for 1905.*

| Day. | Apr. | May. | June. | July | Aug. | Sept | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 0.5 | 3.1 | 1.65 | 0.4 | 0.3 | 0.2 |
| 2 | 1.6 | .5 | 3.8 | 1.6 | .4 | .3 | .2 |
| 3 | 1.6 | .5 | 4.0 | 1.3 | .4 | .3 | .2 |
| 4 | 1.6 | .5 | 4.55 | 1.2 | .4 | .3 | .2 |
| 5 | 1.8 | .4 | 4.9 | 1.1 | .4 | .3 | .2 |
| 6 | 1.2 | .4 | 3.7 | 1.1 | .4 | .3 | .2 |
| 7 | .9 | .4 | 3.5 | 1.0 | .4 | .3 | .2 |
| 8 | .9 | .4 | 4.2 | 1.0 | .4 | .3 | .2 |
| 9 | .9 | .5 | 4.4 | 1.0 | .4 | .2 | .2 |
| 10 | .8 | .5 | 3.7 | .9 | .4 | .2 | .2 |
| 11 | .5 | .5 | 2.85 | .9 | .3 | .2 | .2 |
| 12 | .4 | .5 | 2.95 | .8 | .3 | .2 | .2 |
| 13 | .4 | .5 | 3.25 | .8 | .3 | .2 | .2 |
| 14 | .4 | .4 | 3.75 | .8 | .3 | .2 | .2 |
| 15 | .4 | .4 | 3.5 | .8 | .3 | .2 | .2 |
| 16 | .4 | .5 | 3.35 | 1.0 | .3 | .2 | .2 |
| 17 | .4 | .6 | 3.3 | 1.0 | .3 | .2 | .2 |
| 18 | .3 | 1.0 | 2.95 | .8 | .3 | .2 | .2 |
| 19 | .3 | 1.0 | 2.35 | .6 | .3 | .2 | .2 |
| 20 | .3 | 1.4 | 2.1 | .5 | .3 | .2 | .2 |
| 21 | .3 | 1.7 | 2.05 | .5 | .3 | .2 | .2 |
| 22 | .3 | 2.0 | 2.4 | .5 | .3 | .2 | .2 |
| 23 | .3 | 2.3 | 2.55 | .6 | .3 | .2 | .2 |
| 24 | .3 | 2.3 | 2.55 | .6 | .3 | .2 | .2 |
| 25 | .3 | 2.2 | 2.45 | .5 | .3 | .2 | .2 |
| 26 | .4 | 2.2 | 2.6 | .5 | .3 | .2 | .2 |
| 27 | .4 | 2.55 | 2.35 | .5 | .3 | .2 | .2 |
| 28 | .4 | 2.55 | 2.3 | .5 | .3 | .2 | .2 |
| 29 | .4 | 2.3 | 2.0 | .4 | .3 | .2 | .6 |
| 30 | .4 | 2.05 | 1.6 | .4 | .3 | .2 | .8 |
| 31 | | 2.2 | | .5 | .3 | | .3 |

*Station rating table for Eastfork River at Newfork, Wyo., from May 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.20 | 30 | 1.00 | 181 | 1.80 | 445 | 2.60 | 851 |
| .30 | 43 | 1.10 | 208 | 1.90 | 485 | 2.70 | 914 |
| .40 | 58 | 1.20 | 236 | 2.00 | 527 | 2.80 | 979 |
| .50 | 75 | 1.30 | 267 | 2.10 | 572 | 2.90 | 1,046 |
| .60 | 93 | 1.40 | 300 | 2.20 | 621 | 3.00 | 1,115 |
| .70 | 112 | 1.50 | 334 | 2.30 | 674 | 3.10 | 1,262 |
| .80 | 133 | 1.60 | 370 | 2.40 | 731 | | |
| .90 | 156 | 1.70 | 407 | 2.50 | 790 | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is fairly well defined between gage heights 0.2 foot and 2.6 feet. The table has been extended beyond these limits. Above gage height 3.20 feet the rating curve is a tangent, the difference being 76 per tenth.

*Estimated monthly discharge of Eastfork River at Newfork, Wyo., for 1905.*

[Drainage area, 320 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 445 | 43 | 127 | 7,557 | 0.397 | 0.443 |
| May | 820 | 58 | 286 | 17,580 | .894 | 1.03 |
| June | 2,554 | 370 | 1,234 | 73,430 | 3.86 | 4.31 |
| July | 388 | 58 | 147 | 9,039 | .459 | .529 |
| August | 58 | 43 | 47.8 | 2,939 | .149 | .172 |
| September | 43 | 30 | 33.5 | 1,993 | .105 | .117 |
| October | 133 | 30 | 35.8 | 2,201 | .112 | .129 |
| The period | | | | 114,700 | | |

## YAMPA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Yampa River rises in Egeria Park, in the southeastern part of Routt County, Colo., runs in a general northerly direction to Steamboat Springs, and thence westward to its point of junction with Green River, just east of the Colorado-Utah State boundary. Throughout almost its entire course it flows in a succession of open valleys alternating with deep, narrow canyons, the longest and deepest of the canyons being that through which it enters the Green.

The drainage basin of the river lies for the most part within the boundaries of Routt County, which is a little larger than the State of Massachusetts and comprises about 6,000 square miles. Its eastern limit is formed by the Park Mountains, and the melting of the snows on their high peaks is the source of numerous small streams whose waters augment the volume of the river and form its chief perennial supply. Westward from the mountains the basin is largely the eroded and dissected Yampa Plateau, whose wide terraces, abrupt cliffs, and deep-cut gulches and arroyos are the striking features of the region. The general level is over 6,000 feet above sea.

The rocks of the basin are largely of sedimentary origin and embrace chiefly formations of Tertiary and Cretaceous periods. The soils derived from these rocks are friable and soft, with considerable alkali, and large tracts are covered with sagebrush. The forests in the mountainous portion of the basin are composed of coniferous trees, and scattered clumps of piñon and cedars are found in the plateau country. Weather Bureau records show the mean annual precipitation at the town of Lay to be 12.35 inches.

Elk River, Fortification Creek, Elk Head Creek, William River, and Little Snake River are the most important tributaries of the Yampa. The upper basins of these streams are within the forested region, but along their lower courses are many cultivated areas.

Irrigation in the Yampa basin is confined to low bottom lands and scattered first-bench lands, but a number of systems are now under consideration.

## YAMPA RIVER AT STEAMBOAT SPRINGS, COLO.

This station was established May 3, 1904, at the highway bridge at the east end of Steamboat Springs. May 8, 1905, it was reestablished at the new steel highway bridge, about one-fourth mile below the old bridge, in sec. 17, T. 6 N., R. 84 W.

The channel is straight for about 400 feet above and below the station. The left bank is low, but a roadway about 8 feet high leading to the bridge prevents any overflow. The left bank is high and practically clean. The stream does not overflow even at extremely high stages. The bed is composed of rock and gravel, with some sand, and is clean and permanent. There is but one channel at all stages, obstructed to some extent by several large bowlders. The current is swift at high and medium at low stages. Gage heights have a range of about 4.5 feet. Ice conditions during the winter months render gage readings impracticable.

Discharge measurements are made from the upstream side of the single-span bridge, to which the gage is attached. A stay line is used to keep the meter in position during measurements of high stages. The initial point for soundings is the upstream side of the left abutment, marked zero.

A standard chain gage, which was read twice each day during 1905 by Elmer Brightman, is attached to the downstream side of the bridge, 35 feet from the left abutment. The length of the chain is 13.43 feet. The gage is referred to bench marks as follows: (1) The top of the west side of the left abutment of the bridge; elevation 11.50 feet above the zero of the gage. (2) A standard United States Geological Survey iron post, located 100 feet south of the left end of the old wooden bridge, one-fourth mile up the river; elevation, 15.65 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 70–72.

*Discharge measurements of Yampa River at Steamboat Springs, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 8 | H. G. Graham | 98 | 334 | 2.05 | 4.50 | 684 |
| May 9 | do | 92 | 220 | 3.71 | 5.60 | 816 |
| June 10 | Hinderlider and Graham | 97 | 447 | 7.36 | 8.15 | 3,290 |
| Do | do | 97 | 421 | 7.65 | 7.90 | 3,220 |
| July 26 | H. G. Graham | 81 | 88 | 1.45 | 4.25 | 128 |
| August 26 | do | 81 | 63 | .75 | 4.00 | 47 |

*Daily gage height, in feet, of Yampa River, at Steamboat Springs, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 3.65 | 4.95 | 7.5 | 5.15 | 4.38 | 4.0 | 4.18 |
| 2 | 3.65 | 5.0 | 7.7 | 5.65 | 4.3 | 4.0 | 4.18 |
| 3 | 3.65 | 4.9 | 7.85 | 5.4 | 4.3 | 4.0 | 4.1 |
| 4 | 3.7 | 4.65 | 8.4 | 5.15 | 4.25 | 4.0 | 4.1 |
| 5 | 3.75 | 4.55 | 8.7 | 5.05 | 4.18 | 4.02 | 4.1 |
| 6 | 3.75 | 4.15 | 8.25 | 4.9 | 4.2 | 4.15 | 4.1 |
| 7 | 3.75 | 4.45 | 8.6 | 4.8 | 4.22 | 4.18 | 4.08 |
| 8 | 3.75 | 4.55 | 8.68 | 4.72 | 4.18 | 4.18 | 4.08 |
| 9 | 3.8 | 4.75 | 8.68 | 4.68 | 4.15 | 4.12 | 4.08 |
| 10 | 4.05 | 5.65 | 8.15 | 4.65 | 4.2 | 4.1 | 4.08 |
| 11 | 4.05 | 5.62 | 8.65 | 4.52 | 4.25 | 4.1 | 4.08 |
| 12 | 4.0 | 5.6 | 7.75 | 4.52 | 4.38 | 4.02 | 4.08 |
| 13 | 4.05 | 5.48 | 7.75 | 4.42 | 4.32 | 4.1 | 4.08 |
| 14 | 4.05 | 5.38 | 7.5 | 4.42 | 4.25 | 4.1 | 4.08 |
| 15 | 4.0 | 5.32 | 7.65 | 4.42 | 4.18 | 4.08 | 4.08 |
| 16 | 4.15 | 5.55 | 7.3 | 4.32 | 4.15 | 4.02 | 4.08 |
| 17 | 4.15 | 5.75 | 7.08 | 4.32 | 4.12 | 4.02 | 4.08 |
| 18 | 4.25 | 6.05 | 7.02 | 4.3 | 4.02 | 4.02 | 4.08 |
| 19 | 4.25 | 6.22 | 6.85 | 4.3 | 4.0 | 4.02 | 4.06 |
| 20 | 4.25 | 6.45 | 6.8 | 4.32 | 4.0 | 4.08 | 4.12 |
| 21 | 4.15 | 6.75 | 6.72 | 4.3 | 4.0 | 4.08 | 4.18 |
| 22 | 4.15 | 6.85 | 6.72 | 4.28 | 4.0 | 4.08 | 4.18 |
| 23 | 4.15 | 7.1 | 6.35 | 4.25 | 4.0 | 4.02 | 4.18 |
| 24 | 4.15 | 7.25 | 6.2 | 4.18 | 4.0 | 4.02 | 4.18 |
| 25 | 4.15 | 6.95 | 6.0 | 4.15 | 4.0 | 4.08 | 4.18 |
| 26 | 4.15 | 7.02 | 5.88 | 4.12 | 4.0 | 4.08 | 4.18 |
| 27 | 4.25 | 6.95 | 5 65 | 4.18 | 4.0 | 4.08 | 4.18 |
| 28 | 4.3 | 6.95 | 5.5 | 4.32 | 4.0 | 4.08 | 4.18 |
| 29 | 4.35 | 6.8 | 5.4 | 4.35 | 4.0 | 4.1 | 4.18 |
| 30 | 4.75 | 6.82 | 5.2 | 4.35 | 3.98 | 4.18 | 4.18 |
| 31 | ........ | 6.95 | ........ | 4.38 | 4.0 | ........ | 4.18 |

*Station rating table for Yampa River at Steamboat Springs, Colo., from April 1 to May 18, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 130 | 4.10 | 440 | 5.00 | 935 | 5.90 | 1,640 |
| 3.30 | 146 | 4.20 | 485 | 5.10 | .000 | 6.00 | 1,740 |
| 3.40 | 170 | 4.30 | 530 | 5.20 | 1,070 | 6.20 | 1,940 |
| 3.50 | 200 | 4.40 | 580 | 5.30 | 1,145 | 6.40 | 2,150 |
| 3.60 | 232 | 4.50 | 630 | 5.40 | 1,220 | 6.60 | 2,370 |
| 3.70 | 268 | 4.60 | 685 | 5.50 | 1,300 | 6.80 | 2,610 |
| 3.80 | 307 | 4.70 | 745 | 5.60 | 1,380 | 7.00 | 2,850 |
| 3.90 | 350 | 4.80 | 805 | 5.70 | 1,465 | 7.20 | 3,110 |
| 4.00 | 395 | 4.90 | 870 | 5.80 | 1,550 | 7.40 | 3,400 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1904, and is fairly well defined.

*Station rating table for Yampa River at Steamboat Springs, Colo., from May 19 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.90 | 35 | 4.90 | 395 | 5.90 | 1,025 | 6.90 | 1,920 |
| 4.00 | 55 | 5.00 | 445 | 6.00 | 1,105 | 7.00 | 2,030 |
| 4.10 | 80 | 5.10 | 495 | 6.10 | 1,185 | 7.20 | 2,260 |
| 4.20 | 110 | 5.20 | 550 | 6.20 | 1,270 | 7.40 | 2,500 |
| 4.30 | 145 | 5.30 | 610 | 6.30 | 1,355 | 7.60 | 2,750 |
| 4.40 | 180 | 5.40 | 675 | 6.40 | 1,445 | 7.80 | 3,010 |
| 4.50 | 220 | 5.50 | 740 | 6.50 | 1,535 | 8.00 | 3,270 |
| 4.60 | 260 | 5.60 | 805 | 6.60 | 1,625 | 8.20 | 3,540 |
| 4.70 | 305 | 5.70 | 875 | 6.70 | 1,720 | 8.40 | 3,820 |
| 4.80 | 350 | 5.80 | 950 | 6.80 | 1,820 | 8.60 | 4,100 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905, and is fairly well defined.

*Estimated monthly discharge of Yampa River at Steamboat Springs, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 775 | 250 | 418 | 24,870 |
| May | 2,320 | 462 | 1,405 | 86,390 |
| June | 4,240 | 550 | 2,435 | 144,900 |
| July | 840 | 86 | 254 | 15,620 |
| August | 173 | 51 | 92.5 | 5,688 |
| September | 104 | 55 | 73.1 | 4,350 |
| October | 104 | 75 | 88.2 | 5,423 |
| The period | .......... | .......... | .......... | 287,200 |

## YAMPA RIVER NEAR CRAIG, COLO.

This station was established April 30, 1904. It is located on the wagon bridge 1 mile south of Craig, on the road to Meeker, Colo., in sec. 6, T. 6 N., R. 90 W., just below the mouth of Fortification Creek and about 7 miles above the mouth of Williams River.

The channel is straight for 250 feet above and 300 feet below the station. Both banks are low and overflow at extremely high stages. The bed of the stream is composed of sand, gravel, and cobblestones, and is permanent. There is but one channel at all ordinary stages, broken by the piers of the bridge; at high stages the stream flows through the culverts at each end of the bridge, and the current is materially broken by the driftwood which invariably collects at the upper side of the piers. The current is swift at high, but very sluggish at low water. Gage heights have a range of about 6 feet during an ordinary season. Ice in the channel renders gage readings impracticable during the winter months.

Discharge measurements are made from the downstream side of the three-span tubular steel pier bridge. The initial point for soundings is the vertical wall of the old log abutment on the left bank, to which the gage is attached.

The gage, which was read twice each day during 1905 by Lawson Thompson, is a vertical timber 12 feet long, fastened to a pile on the old log abutment at the left end of the bridge. The gage is referred to bench marks as follows: (1) The top of a bolt marked with a cross on the top of the tubular steel and concrete pier on the downstream side of the left abutment of the bridge; elevation, 14.34 feet above the zero of the gage. (2) The top of a bolt marked with a cross on the top of the corresponding pier on the upstream side of the bridge; elevation, 14.37 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 72–74.

*Discharge measurements of Yampa River near Craig, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 5 | H. G. Graham | 181 | 913 | 2.83 | 4.75 | 2,588 |
| June 8 | Hinderlider, Graham, and Hoyt | 204 | 1,474 | 4.91 | 7.72 | 7,234 |
| July 24 | H. G. Graham | 123 | 545 | .82 | 2.70 | 445 |
| August 25 | do | 122 | 447 | .33 | 1.95 | 146 |
| August 27 | do | 122 | 441 | .32 | 1.95 | 139 |

*Daily gage height, in feet, of Yampa River near Craig, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 2.8 | 5.6 | 6.75 | 4.55 | 2.6 | 1.8 | 2.0 |
| 2 | 3.05 | 5.85 | 7.15 | 4.45 | 2.65 | 1.8 | 2.0 |
| 3 | 2.9 | 5.55 | 7.15 | 4.7 | 2.6 | 1.8 | 2.0 |
| 4 | 2.85 | 5.05 | 7.45 | 4.55 | 2.65 | 1.8 | 2.0 |
| 5 | 2.75 | 4.65 | 8.05 | 4.35 | 2.6 | 1.8 | 2.0 |
| 6 | 2.85 | 4.5 | 8.0 | 4.1 | 2.85 | 1.8 | 2.0 |
| 7 | 3.35 | 4.35 | 7.45 | 3.8 | 2.85 | 1.8 | 2.0 |
| 8 | 3.7 | 4.5 | 7.6 | 3.8 | 2.85 | 1.95 | 2.0 |
| 9 | 4.15 | 5.15 | 7.8 | 3.7 | 2.85 | 2.2 | 2.0 |
| 10 | 4.35 | 5.25 | 8.1 | 3.65 | 2.85 | 2.2 | 2.0 |
| 11 | 4.05 | 4.8 | 7.55 | 3.6 | 2.65 | 2.2 | 2.0 |
| 12 | 3.8 | 4.65 | 7.35 | 3.55 | 2.55 | 1.9 | 1.9 |
| 13 | 3.8 | 4.6 | 7.0 | 3.5 | 2.5 | 1.9 | 1.9 |
| 14 | 4.25 | 4.7 | 7.2 | 3.4 | 2.4 | 1.9 | 1.9 |
| 15 | 3.8 | 4.55 | 6.9 | 3.4 | 2.35 | 1.8 | 2.0 |
| 16 | 3.8 | 4.8 | 6.95 | 3.25 | 2.4 | 1.8 | 2.0 |
| 17 | 3.95 | 4.75 | 6.7 | 3.15 | 2.4 | 1.8 | 2.0 |
| 18 | 4.15 | 5.7 | 6.4 | 2.95 | 2.4 | 1.8 | 2.1 |
| 19 | 4.4 | 6.3 | 6.25 | 2.9 | 2.45 | 1.8 | 2.0 |
| 20 | 4.4 | 6.65 | 6.0 | 2.95 | 2.4 | 1.8 | 2.0 |
| 21 | 4.25 | 6.8 | 5.8 | 2.9 | 2.25 | 1.85 | 2.0 |
| 22 | 4.15 | 7.15 | 5.75 | 2.9 | 2.25 | 1.9 | 2.0 |
| 23 | 4.2 | 7.4 | 5.9 | 2.75 | 2.3 | 1.9 | 2.0 |
| 24 | 4.4 | 7.7 | 5.75 | 2.7 | 2.15 | 1.8 | 2.1 |
| 25 | 4.35 | 7.45 | 5.55 | 2.55 | 1.95 | 1.9 | 2.1 |
| 26 | 4.35 | 7.0 | 5.45 | 2.6 | 1.9 | 1.9 | 2.0 |
| 27 | 4.65 | 6.95 | 5.3 | 2.6 | 1.9 | 1.9 | 2.1 |
| 28 | 5.1 | 6.9 | 5.0 | 2.55 | 1.9 | 1.9 | 2.1 |
| 29 | 5.25 | 6.75 | 4.9 | 2.5 | 1.9 | 1.9 | 2.1 |
| 30 | 5.4 | 6.35 | 4.75 | 2.5 | 1.9 | 1.9 | 2.15 |
| 31 | | 6.25 | | 2.5 | 1.8 | | 2.2 |

*Station rating table for Yampa River near Craig, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 100 | 3.00 | 670 | 4.20 | 1,750 | 5.80 | 4,040 |
| 1.90 | 125 | 3.10 | 740 | 4.30 | 1,860 | 6.00 | 4,390 |
| 2.00 | 155 | 3.20 | 810 | 4.40 | 1,980 | 6.20 | 4,750 |
| 2.10 | 190 | 3.30 | 890 | 4.50 | 2,100 | 6.40 | 5,130 |
| 2.20 | 230 | 3.40 | 970 | 4.60 | 2,230 | 6.60 | 5,520 |
| 2.30 | 270 | 3.50 | 1,060 | 4.70 | 2,360 | 6.80 | 5,930 |
| 2.40 | 320 | 3.60 | 1,150 | 4.80 | 2,490 | 7.00 | 6,360 |
| 2.50 | 370 | 3.70 | 1,240 | 4.90 | 2,630 | 7.50 | 7,520 |
| 2.60 | 420 | 3.80 | 1,330 | 5.00 | 2,770 | 8.00 | 8,750 |
| 2.70 | 480 | 3.90 | 1,430 | 5.20 | 3,070 | | |
| 2.80 | 540 | 4.00 | 1,530 | 5.40 | 3,380 | | |
| 2.90 | 600 | 4.10 | 1,640 | 5.60 | 3,700 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905. It is well defined between gage heights 1.9 feet and 4.8 feet.

*Estimated monthly discharge of Yampa River near Craig, Colo., for 1905.*

[Drainage area, 1,730 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 3,380 | 510 | 1,579 | 93,960 | 0.913 | 1.02 |
| May | 8,000 | 1,920 | 4,177 | 256,800 | 2.41 | 2.78 |
| June | 9,000 | 2,425 | 5,713 | 339,900 | 3.30 | 3.68 |
| July | 2,360 | 370 | 1,002 | 61,610 | .579 | .668 |
| August | 570 | 100 | 333 | 20,480 | .192 | .221 |
| September | 230 | 100 | 124 | 7,379 | .072 | .080 |
| October | 230 | 125 | 163 | 10,020 | 0.94 | .108 |
| The period | ........... | ........... | .......... | 790,100 | ............ | .......... |

## YAMPA RIVER NEAR MAYBELL, COLO.

This station was established April 17, 1904. It is located at the Thornburg bridge, 10 miles west of Maybell and 75 miles from Meeker, Colo., in sec. 19, T. 7 N., R. 96 W.

The channel is straight for about 300 feet above and 600 feet below the station. The left bank is low and clean and overflows to a considerable extent during high water. The right bank is high and clean and is not subject to overflow. The bed of the stream is composed of gravel and sand and is shifting. Ice conditions render gage readings impracticable during the winter months. The ordinary range of gage heights is about 6 feet.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is fastened. The initial point for soundings is the edge of the left abutment.

The gage, which was read twice each day during 1905 by Peter Farrell, is a staff fastened to the left downstream edge of the middle pier of the bridge. The bench mark is a United States Geological Survey standard bronze tablet set in the top stone of the right abutment on the downstream side; elevation above the zero of the gage, 10.79 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 75–77.

*Discharge measurements of Yampa River near Maybell, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec. ft.* |
| May 24 | H. G. Graham | 210 | 1,623 | 5.64 | 6.20 | 9,154 |
| May 25 | do | 210 | 1,645 | 5.53 | 6.25 | 9,097 |
| May 27 | do | 210 | 1,496 | 5.23 | 5.60 | 7,824 |
| June 25 | do | 207 | 1,165 | 4.03 | 4.20 | 4,689 |
| June 26 | do | 206 | 1,099 | 3.72 | 3.90 | 4,086 |
| Aug. 18 | do | 172 | 409 | .56 | .45 | 229 |

*Daily gage height, in feet, of Yampa River near Maybell, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 3.9 | 5.8 | 2.4 | 1.55 | 0.1 | 0.3 |
| 2 | 1.35 | 4.2 | 6.0 | 2.25 | 1.2 | .15 | .25 |
| 3 | 1.5 | 4.3 | 5.85 | 2.65 | 1.2 | .15 | .3 |
| 4 | 1.45 | 4.1 | 5.9 | 2.4 | 1.25 | .2 | .35 |
| 5 | 1.25 | 4.1 | 6.0 | 2.4 | 1.15 | .18 | .3 |
| 6 | 1.35 | 3.5 | 6.1 | 2.4 | .95 | .4 | .25 |
| 7 | 1.5 | 4.05 | 6.2 | 2.3 | .95 | .3 | .2 |
| 8 | 1.65 | 4.1 | 6.75 | 2.2 | .8 | .35 | .25 |
| 9 | 2.05 | 3.9 | 5.85 | 1.95 | .7 | .3 | .2 |
| 10 | 2.65 | 3.75 | 5.5 | 1.75 | .5 | .45 | .2 |
| 11 | 2.5 | 3.4 | 5.95 | 1.7 | .55 | .35 | .3 |
| 12 | 2.4 | 3.4 | 6.5 | 1.5 | .4 | .4 | .3 |
| 13 | 2.75 | 3.3 | 6.6 | 1.5 | .45 | .25 | .2 |
| 14 | 2.75 | 3.55 | 6.65 | 1.4 | .4 | .28 | .25 |
| 15 | 2.65 | 3.3 | 6.4 | 1.35 | .2 | .35 | .3 |
| 16 | 2.55 | 3.4 | 5.55 | 1.45 | .3 | .3 | .4 |
| 17 | 2.65 | 3.6 | 4.75 | 1.3 | .25 | .22 | .3 |
| 18 | 2.6 | 4.1 | 4.55 | 1.25 | .35 | .2 | .3 |
| 19 | 2.75 | 4.95 | 4.45 | 1.25 | .4 | .22 | .2 |
| 20 | 2.8 | 5.55 | 4.35 | 1.15 | .35 | .2 | .3 |
| 21 | 2.55 | 5.8 | 4.4 | 1.1 | .35 | .2 | .55 |
| 22 | 2.6 | 5.85 | 4.2 | 1.35 | .3 | .25 | .4 |
| 23 | 2.75 | 6.25 | 4.25 | 1.1 | .15 | .35 | .3 |
| 24 | 2.8 | 6.25 | 4.45 | 1.05 | .3 | .28 | .3 |
| 25 | 2.65 | 6.25 | 4.05 | .9 | .25 | .25 | .15 |
| 26 | 3.05 | 5.75 | 3.9 | 1.2 | .15 | .3 | .2 |
| 27 | 3.1 | 5.65 | 3.75 | 1.15 | .2 | .4 | .25 |
| 28 | 3.4 | 5.7 | 3.4 | 1.05 | .25 | .35 | .35 |
| 29 | 3.35 | 5.9 | 3.3 | 1.15 | .2 | .25 | .4 |
| 30 | 3.75 | 5.9 | 3.15 | 1.3 | .2 | .25 | .3 |
| 31 | | 5.7 | | 1.5 | .2 | | .25 |

*Station rating table for Yampa River near Maybell, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.00 | 100 | 1.30 | 690 | 2.60 | 1,950 | 3.90 | 3,920 |
| .10 | 130 | 1.40 | 760 | 2.70 | 2,080 | 4.00 | 4,100 |
| .20 | 160 | 1.50 | 840 | 2.80 | 2,210 | 4.20 | 4,470 |
| .30 | 190 | 1.60 | 920 | 2.90 | 2,340 | 4.40 | 4,860 |
| .40 | 230 | 1.70 | 1,000 | 3.00 | 2,480 | 4.60 | 5,270 |
| .50 | 270 | 1.80 | 1,090 | 3.10 | 2,620 | 4.80 | 5,710 |
| .60 | 310 | 1.90 | 1,180 | 3.20 | 2,770 | 5.00 | 6,170 |
| .70 | 350 | 2.00 | 1,280 | 3.30 | 2,920 | 5.20 | 6,640 |
| .80 | 400 | 2.10 | 1,380 | 3.40 | 3,080 | 5.40 | 7,120 |
| .90 | 450 | 2.20 | 1,490 | 3.50 | 3,240 | 5.60 | 7,610 |
| 1.00 | 500 | 2.30 | 1,600 | 3.60 | 3,400 | 5.80 | 8,110 |
| 1.10 | 560 | 2.40 | 1,710 | 3.70 | 3,570 | 6.00 | 8,630 |
| 1.20 | 620 | 2.50 | 1,830 | 3.80 | 3,740 | 6.50 | 10,070 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905, and it is well defined.

*Estimated monthly discharge of Yampa River near Maybell, Colo., for 1905.*

[Drainage area, 3,670 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 3,655 | 655 | 1,825 | 108,600 | 0.497 | 0.554 |
| May | 9,325 | 2,920 | 5,581 | 343,200 | 1.52 | .75 |
| June | 10,850 | 2,695 | 6,768 | 402,700 | 1.84 | 05 |
| July | 2,015 | 450 | 968 | 59,520 | .264 | 304 |
| August | 880 | 145 | 303 | 18,630 | .083 | 096 |
| September | 250 | 130 | 185 | 11,010 | .050 | 056 |
| October | 290 | 145 | 188 | 11,560 | .051 | .059 |
| The period | | | | 955,200 | | |

## ELK RIVER NEAR TRULL, COLO.

Elk River rises in the northeastern part of Routt County, Colo., flows southward, and joins Yampa River 6 miles below Steamboat Springs. The drainage basin comprises the western slope of the Park Range and the greater part of it is mountainous, but there is some open prairie land along the river and its larger tributaries. Much of this prairie land is under cultivation, being irrigated by numerous ditches from the streams. Hay is the principal crop, but in the lower portion of the valley cereals are raised to some extent. The higher portions of the basin are covered by heavy forests of pine and spruce. Precipitation consists principally of snow during the winter months.

The gaging station was established May 2, 1904. It is located about 2 miles southeast of Trull post-office, on the stage road between Steamboat Springs and Hayden, Colo., in sec. 32, T. 7 N., R. 85 W., and is below all tributaries.

The channel is straight for 100 feet above and for 300 feet below the station. Both banks are low but are not liable to overflow except at very high stages. The bed of the stream is composed of rock and is permanent. There is but one channel at all stages. The current is swift at all times and exceedingly so at high water. Ice conditions render gage readings impracticable during the winter months. Gage heights have an ordinary range of about 4 feet.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. The initial point for soundings is the vertical wall of the masonry abutment at the left end of the bridge on the downstream side. There is also a stay-wire about 50 feet above the bridge for holding the meter at high stages.

The gage was read twice each day during 1905 by H. W. Hitchins. The original gage was timber, placed vertically near the right end of the bridge. This was replaced June 22, 1904, by a standard chain gage, referred to the same datum. The chain hangs from a point 25 feet from the initial point for soundings on the downstream side of the bridge. The length of the chain is 16.20 feet. The bench mark is a United States Geological Survey standard aluminum bench-mark tablet, set on the downstream end of the masonry abutment at the right end of the bridge; elevation, 15.995 feet above datum of gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 78-80.

*Discharge measurements of Elk River near Trull, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 7.. .. | H. G. Graham.......................... | 115 | 315 | 2.95 | 7.28 | 931 |
| June 11........ | Hinderlider and Graham .......... | 115 | 449 | 6.01 | 8.78 | 2,698 |
| July 25......... | H. G. Graham.......................... | 95 | 125 | 2.31 | 6.00 | 289 |
| August 26..... | .....do.................................... | 86 | 47 | 2.30 | 5.20 | 108 |

*Daily gage height, in feet, of Elk River near Trull, Colo., for 1905.*

| Dav. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1............ | ....... | 8.9 | 7.72 | 6.0 | 5.1 | 17............ | 8.15 | 8.65 | 6.52 | 5.3 | ....... |
| 2............ | ....... | 8.95 | 7.8 | 5.85 | 5.1 | 18............ | 8.5 | 8.55 | 6.38 | 5.3 | ....... |
| 3............ | ....... | 9.08 | 8.52 | 5.78 | 5.1 | 19............ | 8.75 | 8.3 | 6.38 | 5.28 | ....... |
| 4............ | ....... | 9.5 | 7.85 | 5.72 | 5.1 | 20............ | 8.8 | 8.28 | 6.42 | 5.25 | ....... |
| 5............ | ....... | 9.55 | 7.25 | 5.7 | 5.2 | 21............ | 8.9 | 8.4 | 6.3 | 5.2 | ....... |
| 6............ | ....... | 9.1 | 7.15 | 5.65 | 5.25 | 22............ | 9.02 | 8.35 | 6.28 | 5.18 | ....... |
| 7............ | 7.25 | 9.05 | 7.2 | 5.65 | 5.32 | 23............ | 9.22 | 8.45 | 6.32 | 5.15 | ....... |
| 8............ | 7.4 | 9.25 | 7.25 | 5.62 | 5.32 | 24............ | 9.15 | 8.52 | 6.15 | 5.15 | ....... |
| 9............ | 7.9 | 9.42 | 6.95 | 5.6 | 5.22 | 25............ | 8.85 | 8.45 | 6.0 | 5.2 | ....... |
| 10............ | 7.8 | 9.0 | 6.9 | 5.6 | ....... | 26............ | 8.78 | 8.2 | 5.95 | 5.2 | ....... |
| 11............ | 7.5 | 8.78 | 6.85 | 5.65 | ....... | 27............ | 8.8 | 8.05 | 5.9 | 5.2 | ....... |
| 12............ | 7.4 | 8.88 | 6.85 | 5.65 | ....... | 28............ | 8.72 | 8.15 | 5.9 | 5.18 | ....... |
| 13............ | 7.45 | 8.85 | 6.82 | 5.55 | ....... | 29............ | 8.45 | 8.0 | 5.82 | 5.15 | ....... |
| 14............ | 7.45 | 8.88 | 6.7 | 5.52 | ....... | 30............ | 8.3 | 8.1 | 5.88 | 5.18 | ....... |
| 15............ | 7.4 | 8.9 | 6.78 | 5.42 | ....... | 31............ | 8.55 | ....... | 5.88 | 5.15 | ....... |
| 16............ | 7.85 | 8.85 | 6.65 | 5.38 | ....... | | | | | | |

*Station rating table for Elk River near Trull, Colo., from May 2, 1904, to September 9, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.00 | 60 | 6.00 | 312 | 7.00 | 785 | 8.00 | 1,520 |
| 5.10 | 73 | 6.10 | 350 | 7.10 | 845 | 8.20 | 1,710 |
| 5.20 | 88 | 6.20 | 390 | 7.20 | 905 | 8.40 | 1,910 |
| 5.30 | 107 | 6.30 | 430 | 7.30 | 975 | 8.60 | 2,120 |
| 5.40 | 130 | 6.40 | 470 | 7.40 | 1,045 | 8.80 | 2,365 |
| 5.50 | 156 | 6.50 | 520 | 7.50 | 1,115 | 9.00 | 2,630 |
| 5.60 | 184 | 6.60 | 570 | 7.60 | 1,190 | 9.20 | 2,910 |
| 5.70 | 213 | 6.70 | 620 | 7.70 | 1,270 | 9.40 | 3,190 |
| 5.80 | 244 | 6.80 | 670 | 7.80 | 1,350 | 9.60 | 3,485 |
| 5.90 | 277 | 6.90 | 725 | 7.90 | 1,430 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is fairly well defined between gage heights 5.5 feet and 9 feet.

*Estimated monthly discharge of Elk River near Trull, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 7-31 | 2,938 | 940 | 1,841 | 91,290 |
| June | 3,410 | 1,520 | 2,303 | 137,000 |
| July | 2,032 | 250 | 667 | 41,010 |
| August | 312 | 80 | 146 | 8,977 |
| September 1-9 | 111 | 73 | 87.9 | 1,569 |
| The period | | | | 279,800 |

## FORTIFICATION CREEK AT CRAIG, COLO.

Fortification Creek rises near Mount Walba, in northeastern Routt County, Colo., flows westward, southeastward, and southwestward, and joins Yampa River at Craig.

The gaging station was established June 12, 1905. It is located at the highway bridge about one-fourth mile east of Craig, Colo., in sec. 6, T. 6 N., R. 90 W.

The channel is straight for about 50 feet above and 20 feet below the station. The right bank is low and overflows at very high water; the left bank is high. The bed of the stream is composed of sand and silt and is shifting. There is at all stages but one channel, which is dry late in the summer.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is fastened. The initial point for soundings is the lower side of the bridge, flush with the west abutment.

The gage, which was read twice each day by H. W. Rose, a civil engineer who lives at the station, is a vertical staff, fastened to the east abutment on the lower side of the bridge.

A measurement made June 12, 1905, by H. G. Graham, gave the following results: Width, 51 feet area, 84 square feet; mean velocity, 2.52 feet per second; gage height, 4.40 feet; discharge, 212 second-feet.

*Daily gage height, in feet, of Fortification Creek at Craig, Colo., for 1905.*

| Day. | June. | Day. | June | Day. | June. | Day. | June. |
|---|---|---|---|---|---|---|---|
| 1 | 5.55 | 7 | 5.1 | 13 | 4.15 | 19 | 3.2 |
| 2 | 5.92 | 8 | 5.05 | 14 | 3.95 | 20 | 2.95 |
| 3 | 5.88 | 9 | 5.05 | 15 | 3.75 | 21 | 2.85 |
| 4 | 6.2 | 10 | 5.45 | 16 | 3.7 | 22 | 2.75 |
| 5 | 6.4 | 11 | 4.7 | 17 | 3.5 | 23 | 2.7 |
| 6 | 6.1 | 12 | 4.6 | 18 | 3.35 | 24 | 2.7 |

NOTE.—Creek dry after June 24.

## WILLIAMS RIVER AT HAMILTON, COLO.

Williams River rises in the White River Plateau, the highest portion of which reaches an elevation of 11,000 feet. It flows northwestward and unites with Yampa River about 7 miles below Craig. It is joined by numerous small tributaries which drain portions of the Williams River Mountains on the east and the Danforth Hills on the south. The largest of these tributaries is Marapos Creek, which rises near the Milk Creek divide, flows eastward, and joins Williams River at Hamilton. The entire drainage area is hilly or mountainous, and throughout the upper portion of it there are extensive forests, mainly of white pine and spruce. Farther down the forests give way to a growth of willows and cottonwood along the river bottom and oak brush and shrubbery on the hillsides. Agriculture is confined to the narrow valley extending along the river and some of its largest tributaries. Wild hay is the principal crop, and cattle raising is carried on extensively. The precipitation consists chiefly of snow during the winter months. The maximum discharge occurs during the latter part of May.

The gaging station was established April 29, 1904. It is located at the highway bridge at Hamilton, on the stage road from Meeker to Craig, Colo., about 17 miles from Craig, in sec. 20, T. 5 N., R. 91 W.

The channel is straight for about 150 feet above and 100 feet below the station. The right bank is high, rocky, and clean; the left bank is low and wooded, but does not overflow except at extreme high stages. The bed of the stream is composed of cobblestones and gravel, but is shifting. There is but one channel at all stages. Gage heights have an ordinary range of about 3 feet. During the winter season ice obstructs the channel to such an extent that gage readings are impracticable.

Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is the downstream end of the vertical log abutment at the left end of the bridge.

The gage, which during the early part of 1905 was read twice each day by Mrs. Thomas Hamilton, was a 14-foot timber, driven vertically into the bottom of the river, with the upper end fastened to the lower side of the bridge. May 21, 1905, a standard chain gage was installed, the datum being the same as that of the original gage. The length of the chain is 14.94 feet. The gage is referred to bench marks as follows: (1) A nail driven into the top log at the northeast corner of the left abutment of the bridge; elevation, 12.22 feet. (2) The head of a nail driven into a root on the west side of a small cottonwood tree about 25 feet from the left end of the bridge and just east of the road; elevation, 10.08 feet. (3) A nail driven into the southeast corner of the foundation of the blacksmith shop about 25 feet from the left end of the bridge; elevation, 10.08 feet. (4) A United States Geological Survey standard iron post at the southeast corner of the wagon bridge; elevation, 10.77 feet. Elevations are above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 80–82.

*Discharge measurements of Williams River at Hamilton, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 3 | H. G. Graham | 46 | 149 | 2.87 | 4.10 | 428 |
| May 21 | do | 60 | 262 | 4.91 | 6.05 | 1,286 |
| June 7 | Hinderlider, Hoyt, and Graham | 55 | 199 | 4.22 | 5.48 | 840 |
| June 13 | H. G. Graham | 55 | 203 | 4.98 | 5.55 | 1,011 |
| July 23 | do | 39 | 76 | 1.17 | 3.25 | 89 |
| Do | do | 39 | 80 | 1.10 | 3.30 | 88 |
| August 28 | do | 38 | 64 | .55 | 2.90 | 35 |

*Daily gage height, in feet, of Williams River at Hamilton, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 2.78 | 4.25 | 5.95 | 3.8 | 3.48 | 2.78 | 3.02 |
| 2 | 2.8 | 4.55 | 6.02 | 3.85 | 3.25 | 2.8 | 2.95 |
| 3 | 2.8 | 4.15 | 6.05 | 3.82 | 3.2 | 2.82 | 2.95 |
| 4 | 2.78 | 3.78 | 6.5 | 3.75 | 3.12 | 2.85 | 2.92 |
| 5 | 2.75 | 3.7 | 6.4 | 3.62 | 3.0 | 2.88 | 2.9 |
| 6 | 2.78 | 3.6 | 5.82 | 3.65 | 3.08 | 3.05 | 2.9 |
| 7 | 2.78 | 3.52 | 5.75 | 3.6 | 3.0 | 3.08 | 2.88 |
| 8 | 2.88 | 3.8 | 5.82 | 3.55 | 3.0 | 3.0 | 3.35 |
| 9 | 2.95 | 4.4 | 6.15 | 3.5 | 2.98 | 2.98 | 2.9 |
| 10 | 2.95 | 4.32 | 5.72 | 3.4 | 2.92 | 2.88 | 2.95 |
| 11 | 2.92 | 4.1 | 5.32 | 3.6 | 3.0 | 2.88 | 2.85 |
| 12 | 2.95 | 4.0 | 5.3 | 3.3 | 3.1 | 2.85 | 2.9 |
| 13 | 2.9 | 4.08 | 5.4 | 3.35 | 3.15 | 2.82 | 2.98 |
| 14 | 2.92 | 3.95 | 5.35 | 3.3 | 3.05 | 2.9 | 2.92 |
| 15 | 2.92 | 3.95 | 5.40 | 3.25 | 2.98 | 2.85 | 2.95 |
| 16 | 2.95 | 4.3 | 5.40 | 3.12 | 2.92 | 2.82 | 2.95 |
| 17 | 3.0 | 4.9 | 4.85 | 3.18 | 2.8 | 2.78 | 2.98 |
| 18 | 3.0 | 5.32 | 4.95 | 3.2 | 2.82 | 2.85 | 2.92 |
| 19 | 3.1 | 5.6 | 4.78 | 3.2 | 2.88 | 2.88 | 2.85 |
| 20 | 3.15 | 5.95 | 4.60 | 3.45 | 2.9 | 2.85 | 2.85 |
| 21 | 3.1 | 5.92 | 4.65 | 3.58 | 2.88 | 2.92 | 2.88 |
| 22 | 3.02 | 6.28 | 4.65 | 3.38 | 2.82 | 2.92 | 2.9 |
| 23 | 3.05 | 6.65 | 4.78 | 3.28 | 2.82 | 2.85 | 3.0 |
| 24 | 3.1 | 6.62 | 4.65 | 3.18 | 2.85 | 2.88 | 3.05 |
| 25 | 3.18 | 5.9 | 4.4 | 3.05 | 2.9 | 2.88 | 3.0 |
| 26 | 3.18 | 5.82 | 4.3 | 3.05 | 2.95 | 3.0 | 2.98 |
| 27 | 3.28 | 6.0 | 4.18 | 3.05 | 2.9 | 2.98 | 3.0 |
| 28 | 3.6 | 5.6 | 4.08 | 3.5 | 2.85 | 2.92 | 2.98 |
| 29 | 3.65 | 5.22 | 4.05 | 3.2 | 2.85 | 2.98 | 2.98 |
| 30 | 3.82 | 5.28 | 3.92 | 3.12 | 2.8 | 3.05 | 3.0 |
| 31 | ....... | 5.65 | ....... | 3.15 | 2.78 | ....... | 3.0 |

*Station rating table for Williams River at Hamilton, Colo., from April 1 to May 23, 1905*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.70 | 60 | 3.80 | 330 | 4.90 | 720 | 6.00 | 1,240 |
| 2.80 | 80 | 3.90 | 360 | 5.00 | 760 | 6.10 | 1,300 |
| 2.90 | 100 | 4.00 | 390 | 5.10 | 800 | 6.20 | 1,360 |
| 3.00 | 125 | 4.10 | 420 | 5.20 | 845 | 6.30 | 1,430 |
| 3.10 | 150 | 4.20 | 455 | 5.30 | 890 | 6.40 | 1,500 |
| 3.20 | 175 | 4.30 | 490 | 5.40 | 935 | 6.50 | 1,570 |
| 3.30 | 200 | 4.40 | 525 | 5.50 | 980 | 6.60 | 1,640 |
| 3.40 | 225 | 4.50 | 560 | 5.60 | 1,030 | 6.70 | 1,710 |
| 3.50 | 250 | 4.60 | 600 | 5.70 | 1,080 | | |
| 3.60 | 275 | 4.70 | 640 | 5.80 | 1,130 | | |
| 3.70 | 300 | 4.80 | 680 | 5.90 | 1,180 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on two discharge measurements made during 1905. It is not well defined.

*Station rating table for Williams River at Hamilton, Colo., from May 24 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.70 | 15 | 3.80 | 200 | 4.90 | 565 | 6.00 | 1,160 |
| 2.80 | 25 | 3.90 | 225 | 5.00 | 605 | 6.10 | 1,230 |
| 2.90 | 35 | 4.00 | 255 | 5.10 | 650 | 6.20 | 1,310 |
| 3.00 | 50 | 4.10 | 285 | 5.20 | 700 | 6.30 | 1,390 |
| 3.10 | 65 | 4.20 | 315 | 5.30 | 750 | 6.40 | 1,470 |
| 3.20 | 80 | 4.30 | 345 | 5.40 | 800 | 6.50 | 1,550 |
| 3.30 | 95 | 4.40 | 375 | 5.50 | 850 | 6.60 | 1,630 |
| 3.40 | 110 | 4.50 | 410 | 5.60 | 910 | 6.70 | 1,710 |
| 3.50 | 130 | 4.60 | 445 | 5.70 | 970 | | |
| 3.60 | 150 | 4.70 | 485 | 5.80 | 1,030 | | |
| 3.70 | 175 | 4.80 | 525 | 5.90 | 1,090 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is well defined between gage heights 2.9 feet and 3.3 feet.

*Estimated monthly discharge of Williams River at Hamilton, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 336 | 70 | 135 | 8,033 |
| May | 1,675 | 255 | 737 | 45,320 |
| June | 1,550 | 231 | 745 | 44,330 |
| July | 212 | 58 | 115 | 7,071 |
| August | 126 | 23 | 46.6 | 2,865 |
| September | 62 | 23 | 36.6 | 2,178 |
| October | 102 | 30 | 43.6 | 2,681 |
| The period | | | | 112,500 |

## MILK CREEK NEAR AXIAL, COLO.

Milk Creek rises in the northeastern part of Rio Blanco County, Colo., flows northwestward, and enters Yampa River about 20 miles below Craig.

The gaging station was established April 20, 1904. It is located at the highway bridge about 4 miles below Axial, Colo., in sec. 19, T. 4 N., R. 92 W.

The channel is straight for 75 feet above and 50 feet below the station. Both banks are high and clean and do not overflow. The bed of the stream is composed of sand, and shifts to such an extent that it is difficult to obtain a good rating curve. There is but one channel at all stages, the current being swift at high and medium at low water. Gage heights have a range of about 3.5 feet during an ordinary season. Ice conditions render gage readings impracticable during the winter months.

Discharge measurements are made from the lower side of the single-span bridge to which the gage is attached. The initial point for soundings is at the left end of the bridge, at the water's edge, on the downstream side.

The original gage, which was read once each day during 1905 by Mrs. O. M. Hoback, who lives three-fourths of a mile east of the station, is a vertical staff, 10 feet long, driven 2 feet into the sandy bed of the stream, the top being nailed to the bridge timbers. The gage is referred to bench marks as follows: (1) A nail driven about 4 inches above the ground into the east side of a telephone pole 25 feet south of the bridge; elevation, 10.96 feet. (2) A nail driven into the north side of a 12-inch pile at the northeast corner of the bridge; elevation 10.08 feet. (3) A United States Geological Survey standard iron bench-mark post, set July 21, 1904, about 50 feet southeast of the gage rod; elevation 12.33 feet. Elevations are above the zero of the gage.

This station has been discontinued.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, of the United States Geological Survey, pages 83–85.

*Discharge measurements of Milk Creek near Axial, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| 1905. | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 2 | H. G. Graham | 25 | 77 | 2.23 | 5.80 | 172 |
| May 20 | do | 30 | 128 | 1.90 | 6.80 | 242 |
| June 13 | do | 22 | 39 | 1.75 | 4.85 | 68 |
| July 22 | do | 15 | 8.7 | .31 | 3.45 | 2.7 |
| Aug. 28 | do | 16 | 10 | .37 | 3.50 | 3.7 |

*Daily gage height, in feet, of Milk Creek near Axial, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Day. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.6 | 5.5 | 6.45 | 3.45 | 3.7 | 17 | 3.8 | 6.1 | 4.35 | 3.4 | ....... |
| 2 | 3.55 | 5.8 | 6.4 | 3.5 | 3.6 | 18 | 3.8 | 6.5 | 4.25 | 3.4 | ....... |
| 3 | 3.55 | 5.5 | 6.3 | 3.5 | 3.6 | 19 | 4.0 | 6.9 | 4.1 | 3.5 | ....... |
| 4 | 3.5 | 5.3 | 6.35 | 3.5 | 3.6 | 20 | 4.0 | 6.8 | 4.1 | 3.6 | ....... |
| 5 | 3.5 | 4.85 | 6.2 | 3.5 | 3.6 | 21 | 3.9 | 7.1 | 4.0 | 3.5 | ....... |
| 6 | 3.5 | 4.9 | 5.8 | 3.45 | 3.6 | 22 | 3.8 | 6.95 | 3.85 | 3.45 | ....... |
| 7 | 3.55 | 4.8 | 5.6 | 3.5 | 3.5 | 23 | 3.85 | 7.1 | 3.8 | 3.5 | ....... |
| 8 | 3.6 | 4.95 | 5.5 | 3.45 | 3.5 | 24 | 3.9 | 7.15 | 3.7 | 3.45 | ....... |
| 9 | 3.65 | 5.7 | 5.4 | 3.45 | 3.5 | 25 | 4.0 | 6.85 | 3.65 | 3.4 | ....... |
| 10 | 3.75 | 5.8 | 5.15 | 3.5 | 3.5 | 26 | 4.1 | 6.8 | 3.5 | 3.4 | ....... |
| 11 | 3.75 | 5.4 | 4.7 | 3.6 | 3.6 | 27 | 4.2 | 6.8 | 3.5 | 3.4 | ....... |
| 12 | 3.8 | 5.35 | 4.9 | 3.4 | 3.6 | 28 | 4.8 | 6.55 | 3.5 | 3.5 | ....... |
| 13 | 3.9 | 5.25 | 4.8 | 3.5 | 3.5 | 29 | 4.95 | 6.3 | 3.5 | 3.45 | ....... |
| 14 | 3.8 | 5.3 | 4.6 | 3.5 | 3.5 | 30 | 5.15 | 6.2 | 3.5 | 3.5 | ....... |
| 15 | 3.8 | 5.3 | 4.4 | 3.5 | 3.5 | 31 | ....... | 6.4 | ....... | 3.4 | ....... |
| 16 | 3.8 | 5.65 | 4.4 | 3.4 | 3.5 | | | | | | |

*Station rating table for Milk Creek near Axial, Colo., from April 20, 1904, to May 17, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 2 | 4.10 | 48 | 5.00 | 111 | 5.80 | 175 |
| 3.30 | 4 | 4.20 | 55 | 5.10 | 119 | 5.90 | 183 |
| 3.40 | 8 | 4.30 | 62 | 5.20 | 127 | 6.00 | 191 |
| 3.50 | 12 | 4.40 | 69 | 5.30 | 135 | 6.10 | 200 |
| 3.60 | 17 | 4.50 | 76 | 5.40 | 143 | 6.20 | 209 |
| 3.70 | 23 | 4.60 | 83 | 5.50 | 151 | 6.30 | 218 |
| 3.80 | 29 | 4.70 | 90 | 5.60 | 159 | 6.40 | 227 |
| 3.90 | 35 | 4.80 | 97 | 5.70 | 167 | 6.50 | 236 |
| 4.00 | 41 | 4.90 | 104 | | | | |

NOTE.—The above table is applicable only for open channel conditions. It is based on five discharge measurements made during 1904, and it is fairly well defined.

*Station rating table for Milk Creek near Axial, Colo., from May 18 to August 16, 1905.*

| Gage. height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 2 | 4.40 | 41 | 5.40 | 111 | 6.40 | 201 |
| 3.50 | 4 | 4.50 | 46 | 5.50 | 119 | 6.50 | 211 |
| 3.60 | 7 | 4.60 | 52 | 5.60 | 128 | 6.60 | 221 |
| 3.70 | 10 | 4.70 | 58 | 5.70 | 137 | 6.70 | 231 |
| 3.80 | 13 | 4.80 | 65 | 5.80 | 146 | 6.80 | 241 |
| 3.90 | 17 | 4.90 | 72 | 5.90 | 155 | 6.90 | 251 |
| 4.00 | 21 | 5.00 | 79 | 6.00 | 164 | 7.00 | 261 |
| 4.10 | 26 | 5.10 | 87 | 6.10 | 173 | 7.10 | 271 |
| 4.20 | 31 | 5.20 | 95 | 6.20 | 182 | 7.20 | 281 |
| 4.30 | 36 | 5.30 | 103 | 6.30 | 191 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905, and it is fairly well defined.

*Estimated monthly discharge of Milk Creek near Axial, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 123 | 12 | 35.9 | 2,136 |
| May | 276 | 97 | 184 | 11,310 |
| June | 206 | 4 | 70.4 | 4,189 |
| July | 7 | 2 | 3.5 | 215 |
| August 1-16 | 10 | 4 | 5.7 | 181 |
| The period | | | | 18,030 |

### MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Yampa River basin in 1905:

*Miscellaneous discharge measurements made in Yampa River drainage basin in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 26 | Little Snake | Maybell, Colo | 105 | 918 | 5.50 | .......... | 5,050 |
| June 24 | do | do | 99 | 430 | 3.45 | 3.50 | 1,483 |

## WHITE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

White River rises in Trappers Lake, which lies at an elevation of 9,500 feet above sea level in a small mountain basin of the White River Plateau in eastern Garfield County, Colo.; thence it flows westward to its point of junction with Green River in west-central Uinta County, Utah. Throughout its course it occupies a narrow, mountainous valley, with alternating parks and canyons, entering the longest and deepest of the canyons, in which it continues to its mouth, about 8 miles east of the Colorado-Utah State line.

The basin comprises an arid, broken, and much eroded plateau region, which topographically is a continuation of the Grand River Mesa south of Grand River. The headwater portion covers the greater area and is called the White River Plateau; below this and to the south is the Roan or Book Cliffs Plateau. Fragmentary plateaus also occur along the northern side of the river.

Numerous small streams, among which are Marvine Creek and South Fork, join the White in the upper, mountainous portion of the basin. Douglas, Piceance, and Evacuation Creeks, draining the Book Cliffs Plateau, enter White River from the south. In the spring these creeks carry considerable water, derived mainly from melting snow, but in the summer they are very nearly dry.

The rocks of the basin are largely of sedimentary origin, and west of the Great Hog Back the relief features produced by erosion are characteristic and remarkably uniform. The shales and marls, wherever sufficiently compact, have been made into steep, inaccessible bluffs, and sandstones have become vertical cliffs. The stream channels are deeply cut, and the flood waters carry a large amount of silt. The soils derived from these rocks vary from sandy to adobe texture, have practically no organic ingredients, and are very friable, and wind and water are constantly breaking them up and transporting them lower down in the basin each year.

Short grasses cover the tops of many of the ridges, while juniper and piñon overgrow their sides. Greasewood and sage brush occur extensively over dry valleys and along plateau-like ridges. In the moist valleys willows and cottonwoods grow in dense masses. In the White River Forest Reserve, which extends over the greater portion of the headwaters, and in general at elevations above 7,500 feet, quaking aspens and spruce predominate, while along the plateaus piñon and cedars are more in evidence.

The mean annual precipitation recorded at Meeker is 15.9 inches; farther west and at lower elevations it is undoubtedly much less.

Numerous ditches along the main stream and some of its tributaries divert water for irrigation, which has been practiced in a desultory way for many years. Native hay and kindred products are the chief agricultural staples in the upper part of the area, while grains, grasses, alfalfa, and some fruits are grown in the lower valleys.

## NORTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 28, 1903. It is located at the county bridge at Rawson's ranch, below the mouth of Marvine Creek, 7 miles from Buford, the nearest post-office, and 32 miles from Meeker, Colo.

The channel is straight for 200 feet above and 300 feet below the station. Both banks are high and are not liable to overflow. The bed of the stream is rocky and is free from vegetation. There is but one channel at all stages, broken by the two narrow bridge piers. The current is swift.

Discharge measurements are made from the three-span highway bridge to which the gage is attached. The bridge has a total span of 85 feet. The initial point for soundings is the edge of the abutment at the south end of the bridge.

The gage, which is read twice each day by H. N. Rawson, is a timber spiked to the lower side of the first pier from the south end of the bridge. It reads from 1 foot to 9 feet. The gage is referred to bench marks as follows: (1) The top of a bolt on the bridge nearest the gage; elevation, 11.51 feet. (2) A spike in the trunk of a large cottonwood tree at the southeast corner of the bridge; elevation, 7.46 feet. (3) A spike in one of the abutment logs at the end of the upper sill at the southwest corner of the bridge; elevation, 7.88 feet. Elevations are above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp; 99-100, 133, pp 91-92.
Discharge: 100, p 100; 133, p 92.
Discharge, monthly: 100, p 101; 133, p 93.
Gage heights: 100, p 100; 133, p 92.
Rating table: 100, p 100; 133, p 93.

*Discharge measurements of North Fork of White River near Buford, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 15 | H. G. Graham | 86 | 111 | 3.03 | 2.20 | 336 |
| June 17 | do | 86 | 205 | 5.82 | 3.30 | 1,194 |
| July 6 | do | 88 | 129 | 3.16 | 2.35 | 408 |
| July 18 | do | 87 | 107 | 2.93 | 2.15 | 314 |
| August 12 | do | 87 | 102 | 2.95 | 2.15 | 301 |
| September 16 | do | 86 | 80 | 1.90 | 1.85 | 152 |

*Daily gage height, in feet, of North Fork of White River near Buford, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.82 | 2.55 | 3.4 | 2.65 | 2.2 | 1.9 | 1.85 |
| 2 | 1.85 | 2.5 | 3.4 | 2.6 | 2.15 | 1.9 | 1.85 |
| 3 | 1.82 | 2.3 | 3.6 | 2.52 | 2.1 | 1.9 | 1.85 |
| 4 | 1.82 | 2.18 | 3.8 | 2.42 | 2.1 | 1.9 | 1.85 |
| 5 | 1.82 | 2.12 | 3.8 | 2.42 | 2.05 | 2.0 | 1.85 |
| 6 | 1.82 | 2.15 | 3.7 | 2.4 | 2.05 | 1.98 | 1.85 |
| 7 | 1.9 | 2.22 | 3.85 | 2.38 | 2.0 | 1.95 | 1.85 |
| 8 | 1.88 | 2.48 | 4.0 | 2.35 | 2.0 | 1.9 | 1.85 |
| 9 | 1.92 | 2.48 | 3.9 | 2.32 | 2.0 | 1.9 | 1.85 |
| 10 | 1.92 | 2.32 | 3.6 | 2.3 | 1.98 | 1.9 | 1.85 |
| 11 | 1.92 | 2.28 | 3.5 | 2.28 | 2.05 | 1.9 | 1.85 |
| 12 | 1.92 | 2.22 | 3.55 | 2.28 | 2.1 | 1.9 | 1.85 |
| 13 | 1.92 | 2.22 | 3.62 | 2.28 | 2.02 | 1.9 | 1.85 |

*Daily gage height, in feet, of North Fork of White River near Buford, Colo., in 1905*—Con.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 14 | 1.92 | 2.2 | 3.68 | 2.22 | 2.0 | 1.9 | 1.85 |
| 15 | 1.92 | 2.22 | 3.7 | 2.22 | 2.0 | 1.9 | 1.85 |
| 16 | 1.92 | 2.58 | 3.55 | 2.18 | 1.95 | 1.85 | 1.85 |
| 17 | 1.92 | 2.75 | 3.45 | 2.18 | 1.95 | 1.85 | 1.85 |
| 18 | 1.92 | 2.95 | 3.4 | 2.2 | 1.95 | 1.9 | 1.85 |
| 19 | 1.92 | 3.02 | 3.32 | 2.2 | 1.95 | 1.85 | 1.85 |
| 20 | 1.92 | 3.38 | 3.3 | 2.3 | 1.95 | 1.85 | 1.85 |
| 21 | 1.92 | 3.55 | 3.25 | 2.22 | 1.9 | 1.85 | 1.85 |
| 22 | 1.92 | 3.65 | 3.2 | 2.2 | 1.9 | 1.85 | 1.85 |
| 23 | 1.98 | 3.7 | 3.2 | 2.15 | 1.9 | 1.85 | 1.85 |
| 24 | 1.98 | 3.35 | 3.2 | 2.15 | 1.9 | 1.85 | 1.85 |
| 25 | 1.98 | 3.25 | 3.15 | 2.15 | 1.9 | 1.92 | 1.85 |
| 26 | 2.02 | 3.25 | 3.2 | 2.15 | 1.9 | 1.92 | 1.85 |
| 27 | 2.05 | 3.28 | 3.0 | 2.15 | 1.9 | 1.85 | 1.85 |
| 28 | 2.1 | 3.05 | 2.85 | 2.15 | 1.92 | 1.85 | 1.85 |
| 29 | 2.2 | 2.95 | 2.78 | 2.15 | 1.92 | 1.85 | 1.85 |
| 30 | 2.32 | 3.05 | 2.72 | 2.1 | 1.9 | 1.9 | 1.85 |
| 31 | ........ | 3.25 | ........ | 2.15 | 1.92 | ........ | 1.85 |

*Station rating table for North Fork of White River near Buford, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 135 | 2.40 | 450 | 3.00 | 910 | 3.60 | 1,505 |
| 1.90 | 180 | 2.50 | 515 | 3.10 | 1,000 | 3.70 | 1,610 |
| 2.00 | 225 | 2.60 | 585 | 3.20 | 1,095 | 3.80 | 1,720 |
| 2.10 | 275 | 2.70 | 660 | 3.30 | 1,195 | 3.90 | 1,835 |
| 2.20 | 330 | 2.80 | 740 | 3.40 | 1,295 | 4.00 | 1,950 |
| 2.30 | 390 | 2.90 | 825 | 3.50 | 1,400 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 2.4 feet.

*Estimated monthly discharge of North Fork of White River near Buford, Colo., for 1905.*

[Drainage area, 181 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 402 | 144 | 200 | 11,900 | 1.10 | 1.23 |
| May | 1,610 | 286 | 756 | 46,480 | 4.18 | 4.82 |
| June | 1,950 | 676 | 1,332 | 79,260 | 7.36 | 8.21 |
| July | 622 | 275 | 375 | 23,060 | 2.07 | 2.39 |
| August | 330 | 180 | 219 | 13,470 | 1.21 | 1.40 |
| September | 225 | 157 | 176 | 10,470 | .972 | 1.08 |
| October | 157 | 157 | 157 | 9,654 | .867 | 1.00 |
| The period | .............. | .............. | .............. | 194,300 | .............. | .......... |

### SOUTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 25, 1903. It is located at the county bridge at the lower end of a section of the river known as "Stillwater," about 7 miles from Buford, the nearest post-office, and about 30 miles from Meeker, Colo., in T. 1 S., R. 91 W.

The channel is straight for 50 feet above the station and for 300 feet below. Both banks are high and are covered with grass and sagebrush. The bed of the stream below the "Stillwater" and at the station is covered with bowlders, some of which are 2 or 3 feet in diameter. There is but one channel at all stages, broken by the middle pier of the bridge, and the current is swift. During the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

High-water measurements are made from the bridge, which makes an angle of 20° with the normal to the stream. This is taken into account in making the measurements. The initial point for soundings is the edge of the abutment at the west end of the bridge. At low water, measurements are made by wading.

The gage, which was read twice each day during 1905 by Claud Dobbs, is a 10-foot vertical timber spiked to the upper side of the middle pier. The gage is referred to bench marks as follows: (1) The first bolt on the bridge east of the gage; elevation, 11.95 feet. (2) A spike in one of the logs of the abutment at the southwest corner of the bridge; elevation, 8.57 feet. (3) The corner of a large rock 30 feet west of the bridge and north of the road; elevation, 13.14 feet. (4) The top of a pyramid-shaped rock on the east side of the river below the bridge 41 feet distant from the northeast bolt on the bridge tie and projecting 8 inches above the ground; elevation, 7.02 feet. Elevations are above the zero of the gage. The elevation of the station above sea level, as determined by aneroid barometer, is 7,400 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 97-98; 133, p 94.
Discharge: 100, p 98; 133, p 94.
Discharge, monthly: 100, p 99; 133, p 96.
Gage heights: 100, p 98; 133, p 95.
Rating table: 100, p 99; 133, p 96.

*Discharge measurements of South Fork of White River near Buford, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 16 | H. G. Graham | 55 | 91 | 2.93 | 2.80 | 267 |
| June 19 | do | 55 | 251 | 6.39 | 5.70 | 1,603 |
| July 7 | do | 55 | 110 | 3.61 | 3.15 | 397 |
| Juy 19 | do | 55 | 97 | 2.96 | 2.90 | 287 |
| August 13 | do | 55 | 86 | 3.04 | 2.70 | 262 |
| September 19 | do | 55 | 72 | 2.3 | 2.45 | 166 |

*Daily gage height, in feet, of South Fork of White River near Buford, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct |
|---|---|---|---|---|---|---|---|
| 1 | 2.4 | 2.95 | 4.88 | 3.5 | 2.72 | 2.45 | 2.45 |
| 2 | 2.4 | 3.05 | 5.18 | 3.45 | 2.7 | 2.45 | 2.45 |
| 3 | 2.4 | 2.95 | 5.48 | 3.4 | 2.7 | 2.45 | 2.45 |
| 4 | 2.35 | 2.82 | 6.22 | 3.32 | 2.7 | 2.5 | 2.45 |
| 5 | 2.38 | 2.8 | 6.9 | 3.25 | 2.68 | 2.58 | 2.45 |
| 6 | 2.4 | 2.75 | 6.52 | 3.2 | 2.65 | 2.55 | 2.45 |
| 7 | 2.4 | 2.75 | 6.55 | 3.15 | 2.62 | 2.55 | 2.45 |

*Daily gage height, in feet, of South Fork of White River near Buford, Colo., for 1905*—Con.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 8 | 2.42 | 2.75 | 6.68 | 3.12 | 2.6 | 2.55 | 2.45 |
| 9 | 2.45 | 2.85 | 7.4 | 3.05 | 2.6 | 2.5 | 2.45 |
| 10 | 2.48 | 2.85 | 6.85 | 3.05 | 2.6 | 2.5 | 2.42 |
| 11 | 2.48 | 2.85 | 6.28 | 3.02 | 2.7 | 2.48 | 2.45 |
| 12 | 2.5 | 2.78 | 6.25 | 2.98 | 2.7 | 2.45 | 2.45 |
| 13 | 2.5 | 2.8 | 6.5 | 2.95 | 2.68 | 2.45 | 2.45 |
| 14 | 2.5 | 2.78 | 6.12 | 2.92 | 2.6 | 2.45 | 2.45 |
| 15 | 2.5 | 2.75 | 6.42 | 2.9 | 2.6 | 2.45 | 2.45 |
| 16 | 2.5 | 2.85 | 6.75 | 2.88 | 2.6 | 2.45 | 2.45 |
| 17 | 2.5 | 3.0 | 5.75 | 2.85 | 2.55 | 2.45 | 2.45 |
| 18 | 2.5 | 3.18 | 5.6 | 2.85 | 2.55 | 2.45 | 2.45 |
| 19 | 2.55 | 3.4 | 5.2 | 2.88 | 2.55 | 2.45 | 2.4 |
| 20 | 2.55 | 3.55 | 5.0 | 2.92 | 2.52 | 2.45 | 2.32 |
| 21 | 2.5 | 3.65 | 4.7 | 2.88 | 2.5 | 2.45 | 2.38 |
| 22 | 2.5 | 3.92 | 4.8 | 2.82 | 2.5 | 2.45 | 2.42 |
| 23 | 2.5 | 4.35 | 4.95 | 2.8 | 2.5 | 2.45 | 2.45 |
| 24 | 2.5 | 4.45 | 5.05 | 2.78 | 2.5 | 2.45 | 2.45 |
| 25 | 2.55 | 4.22 | 4.5 | 2.75 | 2.5 | 2.45 | 2.45 |
| 26 | 2.55 | 4.38 | 4.45 | 2.75 | 2.5 | 2.45 | 2.45 |
| 27 | 2.6 | 4.45 | 4.15 | 2.75 | 2.5 | 2.45 | 2.45 |
| 28 | 2.65 | 4.45 | 3.92 | 2.72 | 2.48 | 2.45 | 2.45 |
| 29 | 2.7 | 4.22 | 3.7 | 2.7 | 2.5 | 2.45 | 2.45 |
| 30 | 2.8 | 4.22 | 3.6 | 2.7 | 2.48 | 2.52 | 2.45 |
| 31 | ........ | 4.55 | ........ | 2.7 | 2.48 | ........ | 2.45 |

*Station rating table for South Fork of White River near Buford, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.30 | 115 | 3.50 | 510 | 4.70 | 1,050 | 5.90 | 1,725 |
| 2.40 | 145 | 3.60 | 550 | 4.80 | 1,100 | 6.00 | 1,790 |
| 2.50 | 175 | 3.70 | 590 | 4.90 | 1,150 | 6.20 | 1,920 |
| 2.60 | 205 | 3.80 | 630 | 5.00 | 1,200 | 6.40 | 2,060 |
| 2.70 | 235 | 3.90 | 675 | 5.10 | 1,255 | 6.60 | 2,200 |
| 2.80 | 265 | 4.00 | 720 | 5.20 | 1,310 | 6.80 | 2,350 |
| 2.90 | 300 | 4.10 | 765 | 5.30 | 1,365 | 7.00 | 2,500 |
| 3.00 | 335 | 4.20 | 810 | 5.40 | 1,420 | 7.20 | 2,660 |
| 3.10 | 370 | 4.30 | 855 | 5.50 | 1,480 | 7.40 | 2,820 |
| 3.20 | 405 | 4.40 | 900 | 5.60 | 1,540 | | |
| 3.30 | 440 | 4.50 | 950 | 5.70 | 1,600 | | |
| 3.40 | 470 | 4.60 | 1,000 | 5.80 | 1,660 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined between gage heights 2.4 feet and 5.7 feet.

*Estimated monthly discharge of South Fork of White River near Buford, Colo., for 1905.*

[Drainage area, 148 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 265 | 130 | 175 | 10,410 | 1.18 | 1.32 |
| May | 975 | 250 | 497 | 30,560 | 3.36 | 3.87 |
| June | 2,820 | 550 | 1,569 | 93,360 | 10.60 | 11.83 |
| July | 510 | 235 | 324 | 19,920 | 2.19 | 2.52 |
| August | 241 | 169 | 200 | 12,300 | 1.35 | 1.56 |
| September | 199 | 160 | 167 | 9,937 | 1.13 | 1.26 |
| October | 160 | 121 | 157 | 9,654 | 1.06 | 1.22 |
| The period | | | | 186,100 | | |

## WHITE RIVER AT MEEKER, COLO.

This station was established May 24, 1901. It is located about one-half mile above the town of Meeker, at a point where a wagon bridge crosses the stream, on the ranch of L. F. Van Cleave, in sec. 25, T. 1 N., R. 94 W.

The channel is straight for 500 feet above and below the station. Both banks are high and not liable to overflow. The bed of the stream is composed of gravel and cobblestones and seems to be permanent. There is but one channel at all stages. The current is always swift and is extremely so at high water. Gage heights have an ordinary range of about 2.5 feet. During the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

Discharge measurements are made from either the upstream or downstream side of the bridge, the initial point being at the left end.

The gage, which was read twice each day during 1905 by L. F. Van Cleave, consists of a vertical timber nailed to the left abutment of the bridge on the downstream side. The gage is referred to bench marks as follows: (1) The top of a bolt in the truss immediately above the gage rod; elevation, 10.83 feet above the zero of the gage. (2) A standard United States Geological Survey iron post, located 30 feet north of the north end of the bridge; elevation, 8.807 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 66, pp 91-92; 85, p 50; 100, pp 95-96; 133, p 97.
Discharge: WS 50, p 375; 66, p 92; 85, p 51; 100, p 96; 133, p 97.
Discharge, low-water: Ann 22, iv, p 396.
Discharge, monthly: WS 85, p 52; 100, p 97; 133, p 99.
Gage heights: WS 28, p 143; 66, p 92; 85, p 51; 100, p 96; 133, p 98.
Rating tables: WS 85, p 51; 100, p 97; 133, p 98.

*Discharge measurements of White River at Meeker, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 25 | Stiles and Hinderlider | 79 | 166 | 1.80 | 3.60 | 299 |
| April 3 | A. J. Stiles | 79 | 166 | 2.40 | 3.60 | 398 |
| April 29 | H. G. Graham | 79 | 233 | 3.77 | 4.20 | 879 |
| May 1 | do | 79 | 271 | 3.89 | 4.72 | 1,052 |
| May 18 | do | 79 | 316 | 5.04 | 5.20 | 1,593 |
| May 19 | do | 79 | 332 | 5.42 | 5.40 | 1,801 |
| June 5 | do | 79 | 403 | 8.77 | 6.40 | 3,536 |
| June 20 | do | 78 | 332 | 6.40 | 5.60 | 2,126 |
| June 30 | do | 78 | 281 | 4.06 | 4.90 | 1,141 |
| July 14 | do | 78 | 207 | 2.99 | 4.00 | 620 |
| July 15 | do | 78 | 203 | 2.48 | 3.95 | 505 |
| August 5 | do | 78 | 184 | 2.28 | 3.72 | 419 |
| August 7 | do | 78 | 191 | 2.25 | 3.80 | 429 |

*Daily gage height, in feet, of White River at Meeker, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 3.6 | 4.65 | 5.95 | 4.72 | 3.9 | 3.6 | 3.7 |
| 2 | 3.62 | 4.85 | 5.98 | 4.65 | 3.85 | 3.6 | 3.7 |
| 3 | 3.6 | 4.58 | 6.0 | 4.6 | 3.85 | 3.6 | 3.65 |
| 4 | 3.6 | 4.4 | 6.15 | 4.48 | 3.75 | 3.62 | 3.65 |
| 5 | 3.6 | 4.3 | 6.32 | 4.38 | 3.7 | 3.75 | 3.65 |
| 6 | 3.6 | 4.25 | 6.25 | 4.35 | 3.7 | 3.75 | 3.6 |
| 7 | 3.65 | 4.2 | 6.18 | 4.3 | 3.68 | 3.78 | 3.6 |
| 8 | 3.7 | 4.35 | 6.18 | 4.25 | 3.65 | 3.7 | 3.6 |
| 9 | 3.72 | 4.75 | 6.3 | 4.2 | 3.65 | 3.65 | 3.6 |
| 10 | 3.75 | 4.55 | 6.25 | 4.12 | 3.65 | 3.65 | 3.6 |
| 11 | 3.78 | 4.48 | 6.05 | 4.1 | 3.9 | 3.62 | 3.6 |
| 12 | 3.78 | 4.4 | 6.0 | 4.02 | 3.98 | 3.6 | 3.6 |
| 13 | 3.8 | 4.42 | 6.05 | 4.0 | 3.88 | 3.6 | 3.6 |
| 14 | 3.8 | 4.38 | 5.95 | 3.98 | 3.82 | 3.6 | 3.6 |
| 15 | 3.72 | 4.35 | 6.0 | 3.95 | 3.75 | 3.55 | 3.6 |
| 16 | 3.72 | 4.58 | 6.1 | 3.9 | 3.75 | 3.55 | 3.6 |
| 17 | 3.72 | 4.95 | 5.9 | 3.88 | 3.7 | 3.55 | 3.62 |
| 18 | 3.72 | 5.15 | 5.8 | 3.85 | 3.65 | 3.65 | 3.65 |
| 19 | 3.85 | 5.4 | 5.65 | 3.85 | 3.65 | 3.65 | 3.6 |
| 20 | 3.85 | 5.55 | 5.52 | 4.0 | 3.65 | 3.65 | 3.55 |
| 21 | 3.82 | 5.58 | 5.48 | 3.98 | 3.65 | 3.6 | 3.62 |
| 22 | 3.8 | 5.82 | 5.52 | 3.9 | 3.65 | 3.58 | 3.62 |
| 23 | 3.8 | 5.98 | 5.52 | 3.85 | 3.58 | 3.55 | 3.7 |
| 24 | 3.82 | 6.02 | 5.52 | 3.82 | 3.55 | 3.58 | 3.65 |
| 25 | 3.88 | 5.85 | 5.45 | 3.8 | 3.6 | 3.68 | 3.62 |
| 26 | 3.88 | 5.82 | 5.35 | 3.8 | 3.58 | 3.68 | 3.62 |
| 27 | 4.02 | 5.9 | 5.25 | 3.78 | 3.55 | 3.6 | 3.62 |
| 28 | 4.12 | 5.85 | 5.1 | 3.72 | 3.62 | 3.6 | 3.62 |
| 29 | 4.18 | 5.65 | 4.95 | 3.75 | 3.65 | 3.68 | 3.62 |
| 30 | 4.32 | 5.62 | 4.8 | 3.75 | 3.62 | 3.8 | 3.6 |
| 31 | ........ | 5.68 | ........ | 3.82 | 3.6 | ........ | 3.6 |

*Station rating table for White River at Meeker, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.50 | 345 | 4.30 | 700 | 5.10 | 1,420 | 5.90 | 2,580 |
| 3.60 | 370 | 4.40 | 760 | 5.20 | 1,540 | 6.00 | 2,760 |
| 3.70 | 400 | 4.50 | 835 | 5.30 | 1,670 | 6.10 | 2,950 |
| 3.80 | 435 | 4.60 | 910 | 5.40 | 1,800 | 6.20 | 3,140 |
| 3.90 | 480 | 4.70 | 1,000 | 5.50 | 1,940 | 6.30 | 3,330 |
| 4.00 | 530 | 4.80 | 1,090 | 5.60 | 2,080 | 6.40 | 3,530 |
| 4.10 | 580 | 4.90 | 1,190 | 5.70 | 2,240 | | |
| 4.20 | 640 | 5.00 | 1,300 | 5.80 | 2,410 | | |

**NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5, and is fairly well defined.**

*Estimated monthly discharge of White River at Meeker, Colo., for 1905.*

[Drainage area, 634 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 712 | 370 | 443 | 26,360 | 0.699 | 0.780 |
| May | 2,798 | 640 | 1,490 | 91,620 | 2.35 | 2.71 |
| June | 3,370 | 1,090 | 2,444 | 145,400 | 3.85 | 4.30 |
| July | 1,018 | 407 | 572 | 35,170 | .902 | 1.04 |
| August | 520 | 357 | 405 | 24,900 | .639 | .737 |
| September | 435 | 357 | 382 | 22,730 | .603 | .673 |
| October | 400 | 357 | 376 | 23,120 | .593 | .684 |
| The period | | | | 369,300 | | |

## WHITE RIVER NEAR RANGELY, COLO.

This station was established April 14, 1904. It is located at the wagon bridge 1 mile west of Rangely, Colo., in sec. 3, T. 2 N., R. 102 W.

The channel is curved at the station and the bridge makes an angle of 15° with the radius of the curve. The right bank is high and clean and does not overflow; the left bank is low and clean, and overflows at high stages. The bed of the stream is composed of sand and gravel and is shifting. There is but one channel at all stages. There is an island about 200 feet above the bridge which breaks the current and causes it to run diagonally across the channel in various directions. The current is swift at all times and at high stages surges rapidly. Conditions at this station are unfavorable for accurate measurements, but there is no other available point on this section of the stream.

Discharge measurements are made from the downstream side of the single-span bridge, to which the gage is attached. The initial point for soundings is the vertical wall of the right abutment.

The gage, which was read twice each day during 1905 by Miss Zinnie Coltharp, is a 12-foot timber fastened to the downstream side of the right abutment of the bridge. The bench mark is a United States Geological Survey standard aluminum tablet, set on the top stone of the right abutment on the downstream side of the bridge; elevation, 16.86 feet above the zero of the gage.

This station was abandoned December 31, 1905.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 99-101.

*Discharge measurements of White River near Rangely, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 30 | A. J. Stiles | 79 | 208 | 2.53 | 3.70 | 526 |
| June 2 | H. G. Graham | 90 | 515 | 6.48 | 5.90 | 3,336 |
| June 3 | do | 90 | 521 | 6.63 | 6.00 | 3,457 |
| July 11 | do | 78 | 239 | 2.51 | 3.95 | 600 |
| August 3 | do | 77 | 238 | 2.46 | 3.90 | 587 |
| September 5 | do | 77 | 260 | 3.07 | 4.20 | 798 |

*Daily gage height, in feet, of White River near Rangely, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 3.78 | 4.25 | 5.62 | 4.8 | 3.94 | 3.75 | 4.88 |
| 2 | 3.68 | 4.5 | 5.85 | 4.8 | 3.92 | 3.78 | 4.82 |
| 3 | 3.79 | 4.5 | 5.98 | 4.78 | 3.9 | 3.8 | 4.38 |
| 4 | 3.81 | 4.3 | 6.0 | 4.75 | 3.9 | 3.82 | 4.18 |
| 5 | 3.72 | 4.2 | 6.0 | 4.75 | 3.9 | 4.15 | 4.05 |
| 6 | 3.66 | 4.1 | 6.22 | 4.58 | 3.88 | 4.18 | 3.92 |
| 7 | 3.69 | 4.0 | 6.38 | 4.45 | 3.9 | 4.14 | 3.78 |
| 8 | 3.78 | 4.0 | 6.22 | 4.18 | 3.9 | 4.1 | 3.7 |
| 9 | 3.82 | 4.1 | 6.3 | 4.14 | 3.88 | 4.1 | 3.72 |
| 10 | 3.9 | 4.42 | 6.32 | 4.14 | 3.86 | 3.98 | 3.78 |
| 11 | 3.9 | 4.35 | 6.45 | 4.1 | 3.89 | 3.99 | 3.85 |
| 12 | 3.88 | 4.26 | 6.55 | 3.96 | 3.9 | 3.96 | 3.89 |
| 13 | 3.88 | 4.22 | 6.38 | 3.89 | 3.9 | 3.95 | 3.9 |
| 14 | 3.88 | 4.2 | 6.12 | 3.84 | 3.88 | 3.8 | 3.89 |
| 15 | 3.81 | 4.22 | 6.15 | 3.82 | 3.9 | 3.8 | 3.89 |
| 16 | 3.81 | 4.24 | 6.0 | 3.79 | 3.89 | 3.85 | 3.9 |
| 17 | 3.74 | 4.28 | 6.11 | 3.82 | 3.88 | 3.8 | 3.9 |
| 18 | 3.75 | 4.5 | 6.15 | 3.84 | 3.89 | 3.85 | 3.88 |
| 19 | 3.76 | 4.78 | 5.85 | 3.82 | 3.9 | 3.85 | 3.88 |
| 20 | 3.78 | 4.6 | 5.5 | 3.84 | 3.89 | 3.9 | 3.9 |
| 21 | 3.82 | 5.15 | 5.36 | 3.82 | 3.86 | 3.85 | 3.9 |
| 22 | 3.81 | 5.84 | 5.29 | 3.86 | 3.85 | 3.82 | 3.9 |
| 23 | 3.81 | 5.92 | 5.22 | 3.89 | 3.89 | 3.92 | 3.9 |
| 24 | 3.8 | 6.0 | 5.32 | 3.9 | 3.92 | 3.88 | 3.88 |
| 25 | 3.81 | 6.16 | 5.26 | 3.81 | 3.91 | 3.85 | 3.88 |
| 26 | 3.83 | 6.28 | 5.19 | 3.85 | 3.92 | 3.9 | 3.9 |
| 27 | 3.85 | 5.95 | 5.08 | 3.88 | 3.95 | 3.92 | 3.91 |
| 28 | 3.88 | 5.92 | 4.99 | 3.89 | 3.95 | 4.75 | 3.92 |
| 29 | 3.92 | 5.98 | 4.95 | 3.89 | 3.88 | 4.92 | 3.9 |
| 30 | 4.0 | 5.92 | 4.92 | 3.9 | 3.85 | 4.98 | 3.9 |
| 31 | | 5.5 | | 3.9 | 3.81 | | 3.9 |

*Station rating table for White River near Rangely, Colo., from April 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.60 | 380 | 4.40 | 1,010 | 5.20 | 2,020 | 6.00 | 3,490 |
| 3.70 | 435 | 4.50 | 1,110 | 5.30 | 2,180 | 6.10 | 3,710 |
| 3.80 | 495 | 4.60 | 1,220 | 5.40 | 2,350 | 6.20 | 3,930 |
| 3.90 | 565 | 4.70 | 1,330 | 5.50 | 2,520 | 6.30 | 4,160 |
| 4.00 | 645 | 4.80 | 1,450 | 5.60 | 2,700 | 6.40 | 4,390 |
| 4.10 | 730 | 4.90 | 1,580 | 5.70 | 2,890 | 6.50 | 4,630 |
| 4.20 | 820 | 5.00 | 1,720 | 5.80 | 3,080 | 6.60 | 4,870 |
| 4.30 | 910 | 5.10 | 1,870 | 5.90 | 3,280 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and is not well defined.

*Estimated monthly discharge of White River near Rangely, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 645 | 413 | 506 | 30,110 |
| May | 4,114 | 645 | 1,752 | 107,700 |
| June | 4,750 | 1,608 | 3,152 | 187,600 |
| July | 1,450 | 489 | 748 | 45,990 |
| August | 605 | 502 | 561 | 34,500 |
| September | 1,692 | 381 | 674 | 40,110 |
| October | 1,554 | 435 | 636 | 39,110 |
| The period | | | | 485,100 |

## MARVINE CREEK NEAR BUFORD, COLO.

Marvine Creek rises in Marvine Lake, in the southeastern part of Rio Blanco County, Colo., and flows northwestward to its point of junction with White River.

The gaging station was established July 27, 1903. It is located at a point where the stream is crossed by a large aspen log. The station is 10 miles from Buford, the nearest post-office, and is about 35 miles from Meeker.

The channel is 30 feet wide and is straight for 100 feet above and below the station. The right bank is sloping and will overflow for 10 or 15 feet at high water. The left bank is steep and is not liable to overflow. Both banks are covered with thick brush. The bed of the stream is covered with bowlders and is free from vegetation. The channel is divided into two parts by a large sunken log, which supports the middle of the footbridge. The current is swift.

Discharge measurements are made from the log which spans the stream at the gage. The initial point for soundings is at the gage rod.

The gage, which is read twice daily by James Fitzgerald, is a vertical 5-foot timber, fastened to the lower side of the foot log, which is used as a bridge. It is referred to bench marks as follows: (1) The top of a rock 22 feet west of the gage rod; elevation, 4.62 feet. (2) The top of a triangular-shaped rock between two spruce trees on the west bank; elevation, 6.01 feet. (3) The top of a large rock 30 feet northwest of the gage; elevation. 4.61 feet. Elevations are above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 101; 133, p 103.
Discharge: 100, p 102; 133, p 103.
Discharge, monthly: 100, p 102; 133, p 105.
Gage heights: 100, p 102; 133, p 104.
Rating table: 100, p 102; 133, p 104.

*Discharge measurements of Marvine Creek near Buford, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 15 | H. G. Graham | 29 | 35 | 2.54 | 1.80 | 90 |
| June 17 | do | 40 | 95 | 7.61 | 3.50 | 723 |
| July 6 | do | 29 | 41 | 3.66 | 2.10 | 150 |
| July 18 | do | 29 | 41 | 3.56 | 2.10 | 146 |
| August 12 | do | 29 | 38 | 3.79 | 2.00 | 144 |
| September 18 | do | 29 | 37 | 3.14 | 1.95 | 116 |

*Daily gage height, in feet, of Marvine Creek near Buford, Colo., for 1905.*

| Day | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | | 1.85 | 2.28 | 2.32 | 2.08 | 1.88 | 1.95 |
| 2 | | 1.85 | 2.28 | 2.28 | 2.02 | 1.88 | 1.95 |
| 3 | | 1.85 | 2.3 | 2.25 | 2.02 | 1.88 | 1.92 |
| 4 | | 1.85 | 2.45 | 2.22 | 2.0 | 1.88 | 1.92 |
| 5 | | 1.85 | 2.52 | 2.2 | 2.0 | 1.95 | 1.9 |
| 6 | | 1.85 | 2.45 | 2.2 | 2.0 | 1.95 | 1.9 |
| 7 | | 1.85 | 2.5 | 2.15 | 1.98 | 1.95 | 1.9 |
| 8 | | 1.85 | 2.68 | 2.15 | 1.98 | 1.92 | 1.9 |
| 9 | | 1.85 | 2.78 | 2.15 | 1.98 | 1.92 | 1.9 |
| 10 | 1.7 | 1.85 | 2.7 | 2.15 | 2.0 | 1.92 | 1.9 |
| 11 | 1.7 | 1.85 | 2.6 | 2.1 | 2.05 | 1.92 | 1.9 |
| 12 | 1.7 | 1.85 | 2.6 | 2.08 | 2.0 | 1.9 | 1.9 |
| 13 | 1.7 | 1.85 | 2.7 | 2.08 | 1.98 | 1.9 | 1.9 |
| 14 | 1.7 | 1.85 | 2.7 | 2.08 | 1.95 | 1.9 | 1.95 |
| 15 | 1.7 | 1.85 | 2.8 | 2.08 | 1.98 | 1.9 | 1.9 |
| 16 | 1.7 | 1.9 | 2.7 | 2.05 | 1.98 | 1.9 | 1.9 |
| 17 | 1.7 | 1.92 | 2.65 | 2.05 | 1.98 | 1.9 | 1.9 |
| 18 | 1.7 | 1.98 | 2.6 | 2.1 | 1.98 | 1.9 | 1.9 |
| 19 | 1.7 | 2.02 | 2.55 | 2.12 | 1.98 | 1.9 | 1.9 |
| 20 | 1.7 | 2.08 | 2.52 | 2.15 | 1.95 | 1.9 | 1.9 |
| 21 | 1.7 | 2.12 | 2.5 | 2.1 | 1.92 | 1.9 | 1.9 |
| 22 | 1.7 | 2.12 | 2.55 | 2.05 | 1.92 | 1.9 | |
| 23 | 1.75 | 2.2 | 2.65 | 2.05 | 1.92 | 1.9 | |
| 24 | 1.75 | 2.15 | 2.55 | 2.05 | 1.92 | 1.92 | |
| 25 | 1.75 | 2.15 | 2.45 | 2.02 | 1.92 | 1.92 | |
| 26 | 1.75 | 2.15 | 2.45 | 2.02 | 1.95 | 1.95 | |
| 27 | 1.75 | 2.18 | 2.45 | 2.02 | 1.95 | 1.95 | |
| 28 | 1.75 | 2.22 | 2.38 | 2.0 | 1.92 | 1.95 | |
| 29 | 1.85 | 2.15 | 2.38 | 2.0 | 1.92 | 1.98 | |
| 30 | 1.85 | 2.15 | 2.35 | 2.0 | 1.92 | 1.95 | |
| 31 | | 2.2 | | 2.08 | 1.92 | | |

*Station rating table for Marvine Creek near Buford, Colo., from April 10 to October 21, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 74 | 2.00 | 126 | 2.30 | 205 | 2.60 | 304 |
| 1.80 | 89 | 2.10 | 150 | 2.40 | 235 | 2.70 | 339 |
| 1.90 | 106 | 2.20 | 177 | 2.50 | 269 | 2.80 | 377 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 2.1 feet.

*Estimated monthly discharge of Marvine Creek near Buford, Colo., for 1905.*

[Drainage area, 50 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April 10-30 | 98 | 74 | 78.6 | 3,274 | 1.57 | 1.23 |
| May | 183 | 98 | 127 | 7,809 | 2.54 | 2.93 |
| June | 377 | 199 | 272 | 16,180 | 5.44 | 6.07 |
| July | 211 | 126 | 153 | 9,408 | 3.06 | 3.53 |
| August | 145 | 110 | 120 | 7,379 | 2.40 | 2.77 |
| September | 122 | 103 | 109 | 6,483 | 2.18 | 2.43 |
| October 1-21 | 116 | 106 | 108 | 4,498 | 2.16 | 1.69 |
| The period | | | | 55,030 | | |

## DUCHESNE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Duchesne River rises in the high peaks of the Uinta and Wasatch mountains, flows in a general southeasterly direction, and enters Green River 3 miles above the mouth of the White. It is a very crooked stream, swinging back and forth across its valley, its course marked by a thick line of cottonwoods.

The principal tributaries of the Duchesne are Strawberry, East, and Lake creeks and Uinta River. From the mouth of Strawberry Creek down to Lake Creek the valley of the Duchesne averages 2 miles in width and is bordered on both sides by sandstone bluffs approximately 200 feet high. The cliffs on the northern side of the river are capped by a heavy deposit of coarse river gravel and cobblestones.

Strawberry Creek, the main upper tributary of the Duchesne, drains an area of 1,166 square miles. The stream rises in the Uinta Mountains and the run-off is derived chiefly from melting snow except during the late summer, when the flow comes from small springs well distributed over the entire drainage basin. Numerous tributaries enter the stream, particularly from the north and west, Indian, Bryants Fork, Mud, Horse, Sugar Springs, and Co-op creeks being the principal ones. They are all short and fall rapidly until they reach the valley, through which they flow sluggishly in well-defined channels. The main stream traverses the valley from north to south and is very sluggish. Very little sediment is carried by the stream at any stage. The average elevation of Strawberry Valley is 7,500 feet, which is rather high for agricultural purposes but is splendidly adapted to grazing. Indian Creek, on which a gaging station was maintained during 1905, drains a small portion of the southern slopes of the Uinta Mountains. Its basin comprises smooth, rolling hills, fairly well timbered with pine and aspen. The normal flow is derived chiefly from springs.

The greater part of the precipitation is in the form of snow, which covers the ground for six or eight months each year.

Uinta River and its principal tributary, Whiterocks River, have their sources in a series of lakes in the Uinta Mountains, fed by the snow that exists the year round in the canyons and on the high slopes. The upper drainage area of these streams is very mountainous and difficult of access. After leaving their canyons, 7 or 8 miles above the Indian agency at Whiterocks, the rivers flow southeastward, uniting in various channels between the agency and Fort Duchesne, from which point they flow in one channel, entering Duchesne River 6 miles below, near the Ouray Indian school. Pole, Farm, and Dry Gulch creeks are small tributaries of the Uinta.

## STRAWBERRY CREEK IN STRAWBERRY VALLEY, UTAH.

This station was established May 2, 1903. It is located in the canyon about one-fourth mile above the junction of Strawberry and Indian creeks, and is somewhat inaccessible, the nearest settlement being Heber, 40 miles away. The chief object of the station is the determination of the amount of water available for storage in Strawberry Valley.

The channel is straight for about 600 feet above and 400 feet below the station. The banks are wooded and are sufficiently high to prevent overflow. The bed of the stream is composed of gravel and during the summer months is overgrown with moss and weeds. The current is sluggish. The stream is frozen during the winter months.

Discharge measurements are made by means of a cable and car of regular form. The initial point for soundings is the first metal tag on the tagged wire at the left bank.

Gage readings and discharge measurements during 1905 were made by T. C. Callister. The original gage was of the vertical type and was used until September, 1904, when a new, inclined gage was established at the same locality, about 1,000 feet above the cable. The datum of the new gage is the same as that of the old. The bench mark is a large sandstone bowlder S. 82° E. 175 feet from the gage, 12 feet from the bank of the river, and projecting about 3 feet above the ground. It is marked "Rec. Ser. B. M. No. 7;" elevation, 19.15 feet above the zero of the gage, and 7,496 feet above sea level. July 2, 1905, a low-water station was established at a riffle about 200 feet below the regular gage, where the velocity is sufficiently high to prevent the growth of vegetation, which interferes seriously with the results at the regular station during the summer months. The gage at this point is a vertical staff driven into the stream bed and is referred to bench mark No. 7, above described, its zero having an elevation of 19.93 feet. The annual discharge at this station is therefore represented by two discharge curves.

Beginning April 15, 1905, evaporation and precipitation observations were made at a point near the station. The evaporation records are obtained by means of a 4 by 4 by 4 foot metallic tank set in the ground with its top about 3 inches from the surface. The equipment used in obtaining the precipitation records is of the standard form used by the United States Weather Bureau stations and was furnished by Doctor Hyatt, director of the Utah division of the United States Weather Bureau. The results of the expermients are shown in the following tables:

*Evaporation in Strawberry Valley, Utah.*

| | Inches. |
|---|---|
| April | 1.43 |
| May | 2.37 |
| June | 5.68 |
| July | 6.03 |
| August | 4.71 |
| September | 3.20 |
| October | 1.31 |

*Precipitation in Strawberry Valley, Utah.*

| | Inches. |
|---|---|
| April | 1.01 |
| May | 1.06 |
| June | .17 |
| July | 1.08 |
| August | 1.28 |
| September | 3.04 |
| October | .78 |
| November | Missing. |
| December | 2.00 |

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 100, p 112; 133, p. 121.
Discharge: Ann 21, iv, p 322; 22, iv, p 384; WS 50, p 374; 100, p 112, 133, pp 121, 363.
Discharge, monthly: WS 100, p 113; 133, p 122.
Gage heights: WS 100, p 113.
Rating table: WS 100, p 113.

*Discharge measurements of Strawberry Creek in Strawberry Valley, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 8[a] | C. Tanner | 28 | 20 | 1.01 | ........ | 20 |
| April 17 | T. C. Callister | 64 | 75 | 1.63 | 1.43 | 122 |
| April 21 | do | 64 | 81 | 1.72 | 1.64 | 140 |
| April 26 | do | 66 | 179 | 2.61 | 3.15 | 467 |
| May 1 | do | 64 | 125 | 2.1 | 2.28 | 262 |
| May 4 | do | 64 | 96 | 1.83 | 1.86 | 176 |
| May 18 | do | 64 | 112 | 2.01 | 2.12 | 226 |
| May 23 | T. Thomas | 68 | 156 | 2.36 | 2.78 | 368 |
| June 17 | T. C. Callister | 63 | 63 | 1.39 | 1.20 | 87 |
| June 25 | do | 62 | 53 | 1.08 | .98 | 57 |
| July 2[b] | do | 37 | 36 | 1.23 | 1.50 | 44 |
| July 12[b] | do | 37 | 32 | 1.11 | 1.40 | 35 |
| July 28[b] | do | 37 | 29 | .92 | 1.31 | 26 |
| December 8[a] | A. B. Larson | 34 | 41 | .83 | 1.67 | 34 |
| December 9[a] | do | 34 | 45 | .83 | 1.75 | 37 |
| December 11[a] | do | 34 | 50 | .76 | 1.85 | 38 |
| December 13[a] | do | 32 | 46 | .80 | 1.95 | 37 |
| December 18[a] | do | 26 | 46 | .73 | 2.22 | 34 |

[a] Creek frozen.
[b] Measurement made at riffle 200 feet below gage. Gage heights refer to temporary gage at riffle.

*Daily gage height, in feet, of Strawberry Creek in Strawberry Valley, Utah, for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 2.23 | 2.35 | 0.81 | 1.32 | 1.27 | 1.42 | ........ | 1.56 |
| 2 | ........ | 2.11 | 2.34 | 1.5 | 1.32 | 1.3 | 1.38 | 1.37 | 1.58 |
| 3 | ........ | 2.06 | 2.28 | 1.5 | 1.32 | ........ | 1.38 | ........ | 1.56 |
| 4 | ........ | 1.89 | 2.24 | 1.48 | 1.33 | 1.3 | 1.38 | 1.35 | 1.56 |
| 5 | ........ | 1.74 | 2.11 | 1.47 | 1.32 | 1.33 | 1.38 | ........ | 1.54 |
| 6 | ........ | 1.66 | 2.0 | 1.45 | 1.3 | ........ | 1.38 | 1.35 | 1.51 |
| 7 | ........ | 1.64 | 1.96 | 1.44 | 1.29 | 1.35 | 1.35 | ........ | 1.6 |
| 8 | ........ | 1.68 | 1.94 | 1.43 | 1.27 | 1.36 | ........ | 1.38 | 1.67 |
| 9 | ........ | 1.76 | 1.89 | 1.42 | 1.27 | 1.37 | 1.34 | ........ | 1.75 |
| 10 | ........ | 1.76 | 1.76 | 1.41 | ........ | ........ | 1.33 | 1.38 | 1.75 |

*Daily gage height, in feet, of Strawberry Creek in Strawberry Valley, Utah, for 1905*—Con.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 11 | | 1.67 | 1.65 | 1.41 | 1.33 | | 1.35 | | 1.85 |
| 12 | | 1.74 | 1.56 | 1.4 | 1.32 | 1.31 | | | 1.91 |
| 13 | 1.05 | 1.72 | 1.48 | 1.39 | 1.3 | 1.31 | 1.36 | 1.41 | 1.95 |
| 14 | 1.23 | 1.64 | 1.4 | 1.39 | 1.3 | | 1.35 | | 1.99 |
| 15 | 1.3 | 1.6 | 1.3 | 1.48 | 1.28 | | | | 2.09 |
| 16 | 1.34 | 1.7 | 1.28 | 1.41 | 1.27 | 1.3 | 1.33 | | 2.12 |
| 17 | 1.42 | 1.94 | 1.24 | 1.38 | | 1.3 | 1.32 | | 2.15 |
| 18 | 1.42 | 2.08 | 1.25 | 1.36 | | 1.33 | | | 2.22 |
| 19 | 1.53 | 2.2 | 1.17 | 1.35 | 1.25 | 1.3 | 1.47 | | 2.23 |
| 20 | 1.47 | 2.35 | 1.13 | 1.37 | 1.25 | 1.31 | 1.45 | | 2.24 |
| 21 | 1.72 | 2.49 | 1.09 | 1.36 | 1.25 | | | | 2.27 |
| 22 | 1.84 | 2.61 | 1.06 | 1.38 | 1.25 | 1.32 | 1.43 | | |
| 23 | 1.88 | 2.74 | 1.02 | 1.37 | 1.25 | 1.31 | | 1.43 | |
| 24 | 2.24 | 2.59 | 1.0 | 1.35 | | | | | |
| 25 | 2.88 | 2.53 | .98 | 1.35 | | 1.45 | 1.32 | 1.42 | |
| 26 | 2.9 | 2.6 | .95 | 1.33 | | 1.4 | 1.32 | 1.41 | |
| 27 | 2.47 | 2.48 | .93 | 1.3 | | 1.35 | 1.32 | 1.48 | |
| 28 | 2.38 | 2.46 | .9 | 1.31 | 1.3 | | | 1.5 | |
| 29 | 2.14 | 2.3 | .9 | 1.31 | 1.3 | 1.51 | 1.35 | 1.52 | |
| 30 | 2.26 | 2.2 | .89 | 1.31 | 1.31 | 1.49 | | 1.58 | |
| 31 | | 2.26 | | 1.31 | 1.29 | | 1.38 | | |

NOTE.—Gage heights after July 2 refer to new gage at riffle, as the old gage heights were unreliable after that date on account of growing moss.

November 23–26 there was ice along the edges but the flow was unobstructed. November 27–28 back water caused by ice. November 29 to December 31 the creek was frozen completely over. Gage heights are to water surface.

*Station rating table for Strawberry Creek in Strawberry Valley, Utah, from April 13 to July 1, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 41 | 1.40 | 110 | 2.00 | 205 | 2.60 | 329 |
| .90 | 51 | 1.50 | 124 | 2.10 | 224 | 2.70 | 352 |
| 1.00 | 62 | 1.60 | 139 | 2.20 | 243 | 2.80 | 376 |
| 1.10 | 73 | 1.70 | 154 | 2.30 | 263 | 2.90 | 400 |
| 1.20 | 85 | 1.80 | 170 | 2.40 | 284 | 3.00 | 425 |
| 1.30 | 97 | 1.90 | 187 | 2.50 | 306 | | |

NOTE.—The above table is based on nine discharge measurements made during April to June, 1905. It is well defined between gage heights 0.9 foot and 3 feet.

*Station rating table for Strawberry Creek in Strawberry Valley, Utah, from July 2 to November 25, 1905.*

| Gage. height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.25 | 23 | 1.35 | 31 | 1.45 | 39 | 1.50 | 44 |
| 1.30 | 27 | 1.40 | 35 | | | | |

NOTE.—The above table is based on three discharge measurements made during July, 1905. It is well defined.

*Estimated monthly discharge of Strawberry Creek in Strawberry Valley, Utah, for 1905.*

| Month | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 13-30 | 400 | 68 | 192 | 6,855 |
| May | 362 | 139 | 225 | 13,840 |
| June | 274 | 50 | 129 | 7,676 |
| July | 44 | 27 | 34.6 | 2,128 |
| August | 29 | 23 | 26.1 | 1,605 |
| September | 45 | 25 | 30.7 | 1,827 |
| October | 42 | 29 | 32.5 | 1,998 |
| November | 38 | 31 | 35.0 | 2,083 |
| December[a] | 35 | 35 | 35.0 | 2,152 |
| The period | .......... | .......... | .......... | 40,160 |

[a] Daily discharge estimated at 35 second-feet, based on five discharge measurements.

NOTE.—Daily discharge interpolated for missing gage heights.

## INDIAN CREEK IN STRAWBERRY VALLEY, UTAH.

This station was established April 5, 1905. It is located in the canyon about 250 feet above the junction of the creek with Strawberry Creek. It is about 1 mile below the point where Indian Creek leaves Indian Creek Valley and enters the canyon, and is 40 miles from Heber, the nearest post-office. The records will show the amount of water that can be diverted from Indian Creek into the Strawberry Valley storage reservoir.

The channel is straight for about 25 feet above and below the station. The right bank is vertical for about 1½ feet above the bed and then slopes gradually upward; the left bank slopes irregularly from the bed. Both banks are sufficiently high to prevent overflow. The bed of the stream is smooth and rocky and is not liable to shift. A slight growth of moss occurs in the summer, but does not interfere with the rating curve to any great extent. The velocity is medium and the discharge ranges from 20 to 100 second-feet. Definite information in regard to winter conditions is lacking.

Discharge measurements are made from two poles laid across the stream. The initial point for soundings is at the right bank.

The gage, which was read during 1905 by the men at the Reclamation Service camp in Strawberry Valley, under the direction of T. C. Callister, is a large stake driven into the bed about 180 feet above the measuring section. It is referred to a bench mark consisting of a cross on a large sandstone bowlder 50 feet south of the river; elevation, 16.28 feet above the zero of the gage and 7,480 feet above mean sea level.

*Discharge measurements of Indian Creek in Strawberry Valley, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 15 | T. C. Callister | 16 | 16 | 0.87 | 1.00 | 13.5 |
| April 18 | do | 17 | 14 | .91 | 1.00 | 13 |
| April 25 | J. Thomas | 18 | 18 | 1.56 | 1.20 | 28 |
| April 26 | T. C. Callister | 18 | 20 | 1.95 | 1.38 | 40 |
| May 15 | do | 16 | 14 | 1.39 | 1.10 | 18.7 |
| June 17 | do | 16 | 13 | 1.72 | 1.10 | 22 |
| October 14 | do | 16 | 8.3 | 1.10 | .92 | 9.1 |
| December 9[a] | A. B. Larson | 14 | 16 | .63 | 1.46 | 10.1 |
| December 10[a] | do | 14 | 12 | .78 | 1.25 | 9.8 |
| December 11[a] | do | 12 | 18 | .72 | 1.67 | 12.8 |
| December 13[a] | do | 14 | 25 | .52 | 1.81 | 12.9 |
| December 19[a] | do | 13 | 23 | .47 | 2.08 | 10.9 |

[a] Ice measurement.

*Discharge measurements of Indian Creek at point of diversion in Strawberry Valley, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 21 | T. C. Callister | 16 | 6.8 | 1.12 | 0.71 | 7.6 |
| May 3 | Callister and Thomas | 18 | 11 | 1.34 | .92 | 15 |
| May 5 | T. C. Callister | 18 | 16 | 1.62 | 1.11 | 25 |
| May 17 | do | 18 | 16 | 1.62 | 1.11 | 25 |
| May 19 | do | 18 | 19 | 1.77 | 1.3 | 33 |
| May 21 | do | 19 | 21 | 1.78 | 1.41 | 37 |

*Daily gage height, in feet, of Indian Creek in Strawberry Valley, Utah, for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.1 | 1.2 | 1.02 | 1.0 | 0.95 | ........ | ........ | 1.2 |
| 2 | ........ | 1.13 | 1.2 | 1.02 | 1.0 | .95 | 0.96 | ........ | 1.2 |
| 3 | ........ | 1.12 | 1.21 | 1.02 | 1.0 | ........ | .95 | ........ | 1.16 |
| 4 | ........ | 1.1 | 1.2 | 1.02 | 1.0 | .95 | .93 | 0.92 | 1.11 |
| 5 | ........ | 1.08 | 1.2 | 1.02 | 1.0 | 1.0 | .93 | ........ | 1.1 |
| 6 | ........ | 1.06 | 1.19 | 1.02 | .98 | ........ | .93 | .92 | 1.1 |
| 7 | ........ | 1.06 | 1.18 | 1.02 | .98 | 1.0 | .93 | ........ | 1.3 |
| 8 | ........ | 1.1 | 1.17 | 1.02 | .97 | .98 | ........ | .91 | 1.44 |
| 9 | ........ | 1.11 | 1.16 | 1.01 | .98 | .96 | .93 | ........ | 1.46 |
| 10 | ........ | 1.11 | 1.13 | 1.01 | ........ | ........ | .92 | .92 | 1.25 |
| 11 | ........ | 1.1 | 1.11 | 1.0 | 1.0 | ........ | .93 | ........ | 1.67 |
| 12 | ........ | 1.1 | 1.12 | 1.0 | .99 | .95 | ........ | ........ | 1.75 |
| 13 | ........ | 1.11 | 1.12 | 1.0 | 1.0 | .94 | .92 | .86 | 1.81 |
| 14 | 1.0 | 1.09 | 1.11 | 1.0 | .99 | ........ | .92 | ........ | 1.9 |
| 15 | 1.0 | 1.1 | 1.11 | 1.01 | .98 | ........ | ........ | ........ | 1.94 |
| 16 | 1.01 | 1.12 | 1.11 | 1.0 | .97 | .94 | .92 | ........ | 2.0 |
| 17 | 1.02 | 1.19 | 1.1 | 1.0 | ........ | ........ | .92 | ........ | 2.01 |
| 18 | 1.0 | 1.22 | 1.11 | 1.0 | ........ | .95 | ........ | ........ | 2.03 |
| 19 | 1.02 | 1.3 | 1.1 | .99 | .96 | .94 | .95 | ........ | 2.08 |
| 20 | 1.04 | 1.31 | 1.08 | 1.0 | .96 | .93 | .93 | ........ | 2.09 |
| 21 | 1.14 | 1.34 | 1.08 | 1.0 | .96 | ........ | ........ | ........ | 2.16 |
| 22 | 1.15 | 1.37 | 1.06 | 1.0 | .97 | .95 | .92 | ........ | ........ |
| 23 | 1.15 | 1.39 | 1.05 | 1.0 | .95 | .93 | ........ | .88 | ........ |
| 24 | 1.36 | 1.35 | 1.05 | 1.0 | ........ | ........ | ........ | ........ | ........ |
| 25 | 1.56 | 1.32 | 1.05 | 1.0 | ........ | .98 | .92 | .87 | ........ |
| 26 | 1.25 | 1.31 | 1.04 | 1.0 | ........ | .95 | .92 | .88 | ........ |
| 27 | 1.14 | 1.3 | 1.04 | .98 | ........ | .94 | .92 | 1.0 | ........ |
| 28 | 1.15 | 1.29 | 1.03 | 1.0 | .97 | ........ | ........ | 1.2 | ........ |
| 29 | 1.07 | 1.28 | 1.04 | 1.0 | .97 | 1.01 | .94 | 1.58 | ........ |
| 30 | 1.07 | 1.24 | 1.03 | 1.0 | .98 | .99 | ........ | 1.4 | ........ |
| 31 | ........ | 1.24 | ........ | 1.0 | .97 | ........ | .96 | ........ | ........ |

NOTE.—Creek frozen November 27 to December 31.

*Station rating table for Indian Creek in Strawberry Valley, Utah, from April 14 to November 26, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 8.2 | 1.10 | 20 | 1.30 | 35 | 1.50 | 51 |
| 1.00 | 13.2 | 1.20 | 27 | 1.40 | 43 | 1.60 | 59 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 1.4 feet.

*Estimated monthly discharge of Indian Creek in Strawberry Valley, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 14-31 | 56 | 13 | 22.3 | 752 |
| May | 42 | 17 | 27.1 | 1,666 |
| June | 28 | 15 | 20.9 | 1,244 |
| July | 15 | 12 | 13.6 | 836 |
| August | 13 | 11 | 12.1 | 744 |
| September | 14 | 10 | 11.1 | 660 |
| October | 11 | 9 | 9.8 | 603 |
| November | 11 | 6.5 | 8.4 | 500 |
| December [a] | 11 | 11 | 11.0 | 676 |
| The period | | | | 7,681 |

[a] Daily discharge estimated at 11 second-feet, based on five measurements.

NOTE.—Daily discharge interpolated for missing gage heights.

*Table of evaporation at Fort Duchesne, Utah, for 1904.*

| Month. | Total evaporation in inches. |
|---|---|
| August 26-27 | 0.35 |
| September | 3.18 |
| October | 1.84 |
| November 1-16 | .43 |
| Total for period | 5.80 |
| Average daily evaporation | 0.0734 |

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Duchesne River basin in 1904:

*Miscellaneous discharge measurements made in Duchesne River drainage basin 1904.*

| Date. | Stream. | Locality. | Gage height. | Discharge. |
|---|---|---|---|---|
| | | | *Feet.* | *Sec.-ft.* |
| April 21 | Duchesne | Myton, Utah | 6.20 | 901 |
| April 22 | ....do | ....do | 6.08 | 766 |
| May 19 | ....do | ....do | 8.13 | 3,289 |

## PRICE RIVER DRAINAGE BASIN.

### PRICE RIVER NEAR HELPER, UTAH.

Price River rises in the Wasatch Mountains, in the southeastern part of Utah County, flows in a general southeasterly direction, and unites with Green River at a point about 14 miles above Greenriver, Utah. The main source of supply is the snow in the upper reaches of the basin, where elevations range from 8,000 to 9,000 feet. The region is extremely rough and rugged. The principal rock is a loose and badly disintegrated sandstone. There is but little soil and practically no vegetation except for small groves of scrubby cedar and a few scattered pines. The original scanty underbrush and grass have been almost entirely tramped out by sheep and cattle. The river is subject to floods in the spring and early summer, during which time it carries immense quantities of sediment. Gordon and Pleasant creeks are the main tributaries. They are both short, steep streams and enter the river from the west almost at right angles.

The gaging station was established February 21, 1904. It is located on the upper side of the ford near the settlement of Spring Glen, about 3 miles south of Helper, Utah, and 350 feet west of the main line of the Denver and Rio Grande Railroad.

The channel is straight for about 125 feet above and 400 feet below the station, and the banks are sufficiently high to prevent any overflow. The bed of the stream is composed of fine gravel and sand and shifts slightly, especially during high water. Information in regard to winter conditions is incomplete.

Low-water measurements are made by wading. The initial point for soundings is a 2 by 4 inch post driven in the left bank S. 8° W., 2½ feet from the gage. The course of the section is N. 44° W. A 2 by 4 inch post marks the position of the gaging station on the right bank. Measurements during high water are impossible, as there is no provision for crossing except by wading.

The gage, which was read daily during 1905 by John Tryon, is a staff driven into the stream bed and supported at the top by a timber buried in the bank. The gage is referred to bench marks as follows: (1) A Standard United States Geological Survey cap cemented in a sandstone bowlder embedded in the bank at a point S. 65° E. 23 feet from the gage; elevation, 12.55 feet above the zero of the gage, and so marked. (2) A cross chiseled on a large bowlder embedded in the bank S. 6° E. 19.2 feet from the gage, marked "B. M.;" elevation, 11.19 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 128–130.

*Discharge measurements of Price River near Helper, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 21 | C. Tanner | 38 | 25 | 0.87 | 3.35 | 22 |
| February 17 | W. G. Swendsen | 48 | 37 | 1.02 | 3.40 | 38 |
| March 17 | do | 52 | 50 | 1.36 | 3.65 | 68 |
| April 25 | do | 55 | 63 | 1.88 | 3.95 | 119 |
| May 13 | do | 53 | 78 | 1.96 | 4.00 | 154 |
| June 2 | do | 79 | 153 | 3.76 | 4.92 | 575 |
| August 24 | A. B. Larson | 47 | 24 | .48 | 3.22 | 11.5 |

*Daily gage height, in feet, of Price River near Helper, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 3.35 | 3.45 | 3.55 | 4.5 | 4.9 | 3.5 | 3.4 | 3.2 | 3.5 | 3.3 | 3.3 |
| 2 | 3.3 | 3.35 | 3.45 | 3.6 | 4.5 | 4.9 | 3.4 | 3.4 | 3.2 | 3.5 | 3.3 | 3.3 |
| 3 | 3.35 | 3.35 | 3.45 | 3.65 | 4.5 | 4.9 | 3.4 | 3.5 | 3.2 | 3.4 | 3.4 | 3.3 |
| 4 | 3.3 | 3.35 | 3.45 | 3.65 | 4.3 | 4.9 | 3.4 | 3.4 | 3.2 | 3.4 | 3.4 | 3.3 |
| 5 | 3.3 | 3.35 | 3.45 | 3.65 | 4.2 | 4.9 | 3.4 | 3.4 | 3.3 | 3.4 | 3.3 | 3.3 |
| 6 | 3.3 | 3.35 | 3.45 | 3.45 | 4.2 | 4.8 | 3.4 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 |
| 7 | 3.3 | 3.4 | 3.45 | 3.15 | 4.1 | 4.6 | 3.4 | 3.4 | 3.4 | 3.4 | 3.3 | 3.2 |
| 8 | 3.3 | 3.4 | 3.5 | 3.15 | 4.2 | 4.6 | 3.4 | 3.3 | 3.4 | 3.4 | 3.3 | 3.2 |
| 9 | 3.3 | 3.4 | 3.45 | 3.15 | 4.2 | 4.5 | 3.4 | 3.3 | 3.4 | 3.4 | 3.3 | 3.2 |
| 10 | 3.3 | 3.4 | 3.45 | 3.15 | 4.1 | 4.5 | 3.4 | 3.3 | 3.4 | 3.4 | 3.3 | 3.3 |
| 11 | 3.3 | 3.4 | 3.5 | 8.25 | 4.0 | 4.4 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 |
| 12 | 3.3 | 3.4 | 3.4 | 3.35 | 4.0 | 4.3 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 13 | 3.4 | 3.55 | 3.55 | 3.35 | 4.0 | 4.2 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.2 |
| 14 | 3.3 | 3.6 | 3.55 | 3.35 | 4.1 | 4.2 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| 15 | 3.3 | 3.6 | 3.55 | 3.45 | 4.1 | 4.2 | 3.4 | 3.3 | 3.2 | 3.3 | 3.3 | 3.2 |
| 16 | 3.3 | 3.6 | 3.55 | 3.5 | 4.1 | 4.1 | 3.4 | 3.2 | 3.2 | 3.3 | 3.3 | 3.2 |
| 17 | 3.4 | 3.6 | 3.65 | 3.45 | 4.3 | 4.1 | 3.4 | 3.2 | 3.2 | 3.3 | 3.3 | 3.2 |
| 18 | 3.3 | 3.4 | 3.65 | 3.45 | 4.4 | 4.1 | 3.3 | 3.2 | 3.2 | 3.3 | 3.4 | 3.2 |
| 19 | 3.3 | 3.4 | 3.65 | 3.45 | 4.6 | 4.1 | 3.3 | 3.2 | 3.2 | 3.3 | 3.3 | 3.2 |
| 20 | 3.3 | 3.4 | 3.65 | 3.45 | 4.8 | 3.9 | 3.3 | 3.2 | 3.2 | 3.3 | 3.3 | 3.2 |
| 21 | 3.35 | 3.4 | 3.65 | 3.4 | 4.9 | 3.9 | 3.3 | 3.2 | 3.2 | 3.3 | 3.3 | 3.2 |
| 22 | 3.35 | 3.4 | 3.6 | 3.4 | 4.9 | 3.8 | 3.3 | 3.2 | 3.2 | 3.4 | 3.3 | 3.2 |
| 23 | 3.35 | 3.5 | 3.55 | 3.4 | 4.9 | 3.8 | 3.3 | 3.2 | 3.2 | 3.4 | 3.4 | 3.3 |
| 24 | 3.35 | 3.45 | 3.55 | 3.4 | 4.9 | 3.7 | 3.3 | 3.2 | 4.5 | 3.4 | 3.4 | 3.2 |
| 25 | 3.35 | 3.45 | 3.65 | 3.95 | 5.0 | 3.6 | 3.4 | 3.2 | 3.5 | 3.4 | 3.4 | 3.2 |
| 26 | 3.35 | 3.5 | 3.65 | 4.0 | 5.0 | 3.6 | 3.3 | 3.2 | 3.4 | 3.4 | 3.3 | 3.2 |
| 27 | 3.35 | 3.5 | 3.6 | 4.2 | 5.0 | 3.6 | 3.3 | 3.3 | 3.3 | 3.4 | 3.4 | 3.2 |
| 28 | 3.35 | 3.5 | 3.55 | 4.3 | 5.1 | 3.5 | 3.3 | 3.2 | 3.3 | 3.4 | 3.3 | 3.2 |
| 29 | 3.35 | ....... | 3.55 | 4.3 | 5.1 | 3.5 | 3.3 | 3.3 | 6.8 | 3.4 | 3.2 | 3.2 |
| 30 | 3.35 | ....... | 3.45 | 4.4 | 5.1 | 3.5 | 3.3 | 3.3 | 3.6 | 3.4 | 3.3 | 3.2 |
| 31 | 3.35 | ....... | 3.45 | ....... | 4.9 | 3.5 | 3.4 | 3.3 | ....... | 3.3 | ....... | 3.1 |

NOTE. -These gage heights are liable to some error. Observer made no report of ice conditions, but it is probable that the river was frozen for short periods.

*Station rating table for Price River near Helper, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 4 | 3.60 | 60 | 4.10 | 182 | 4.60 | 404 |
| 3.20 | 9 | 3.70 | 78 | 4.20 | 219 | 4.70 | 455 |
| 3.30 | 18 | 3.80 | 98 | 4.30 | 260 | 4.80 | 508 |
| 3.40 | 30 | 3.90 | 122 | 4.40 | 305 | 4.90 | 563 |
| 3.50 | 44 | 4.00 | 150 | 4.50 | 354 | 5.00 | 620 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-1905. It is well defined between gage heights 3.2 feet and 4.9 feet.

*Estimated monthly discharge of Price River near Helper, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January [a] | 30 | 18 | 21.1 | 1,297 |
| February | 60 | 24 | 36.3 | 2,016 |
| March | 69 | 37 | 49.8 | 3,062 |
| April | 305 | 6 | 71.5 | 4,254 |
| May | 678 | 150 | 379 | 23,300 |
| June | 563 | 44 | 254 | 15,110 |
| July | 44 | 18 | 25.8 | 1,586 |
| August | 44 | 9 | 18.8 | 1,156 |
| September | 1,740 | 9 | 87.8 | 5,224 |
| October | 44 | 18 | 26.3 | 1,617 |
| Novemner | 30 | 9 | 20.5 | 1,220 |
| December [a] | 18 | 4 | 12.0 | 738 |
| The year | 1,740 | 4 | 83.6 | 60,580 |

[a] No ice record, discharge applied as for open channel.

## GRAND RIVER DRAINAGE BASIN.

### AREA AND EXTENT.

Grand River and its tributaries drain an area comprising approximately 26,180 square miles, of which 22,290 are in Colorado and the rest in eastern Utah. East and southeast the basin is limited by the high ranges of the Continental Divide, which separate it from the basins of the Platte and the Arkansas rivers. On the north are the White River and Book Cliffs plateaus, while westward it extends to the canyon district of the Colorado .

The tributaries include innumerable small creeks and five large streams, viz, Blue, Eagle, Roaring Fork, Gunnison, and Dolores rivers.

In the following account of the work of the United States Geological Survey in this region during 1905 the basin has been subdivided, the main river being described first and the tributaries afterwards in their order, from the head down.

## GRAND RIVER.

### DESCRIPTION OF BASIN.

Grand River rises on the western slopes of the Rocky Mountains among the high peaks of the Front Range, flows in a general southwesterly direction across Colorado into Utah, and unites with Green River to form the Colorado. From source to mouth the total distance traversed is about 350 miles.

In most respects the Grand is a typical mountain stream, flowing throughout its course in a succession of deep canyons, with precipitous and ofttimes perpendicular walls varying in height up to 3,000 feet above the water's edge, alternating with long, narrow, fertile valleys.

The headwater region, comprising approximately 50 per cent of the basin, consists of a long stretch of the western portion of the Continental Divide, extending from the north-central portion of Colorado southward nearly to the Colorado-New Mexico line, a distance of 260 miles, and separating the waters of the Grand from those of the Platte and Arkansas basins. The area is extremely rugged, elevations ranging from 7,000 to 14,000 feet. Gradients are steep, stream channels are numerous, and tributaries are rapid, the fall varying from 20 to 150 feet. The streams of this region derive their waters chiefly from the snow masses on the Continental Divide and furnish the perennial discharge of the Grand. The intermediate or middle portion of the basin, consisting largely of broken and scoured plateaus of sedimentary origin, contributes a relatively small amount of the run-off, the tributaries being few and, with the exception of Gunnison River, insignificant. The lower portion of the basin, immediately adjacent to the Colorado-Utah State line, is an arid, much eroded region, furnishing an appreciable run-off, which carries a large amount of sediment.

The largest tributaries of the headwater region are Frazer, Williams Fork, Troublesome, Blue, and Muddy rivers, which add their waters to the Grand before it leaves Middle Park. Eagle River comes in near Eagle, just above the point where the river enters Grand River Canyon, and Roaring Fork unites with it just below the mouth of the canyon at Glenwood Springs. At Grand Junction, Colo., the river receives the waters of its largest tributary, Gunnison River, and thereafter no other stream of importance enters until the Dolores comes in, 15 miles west of the Utah boundary.

A peculiar feature of the drainage is what might be termed its one-sided nature, practically all its important tributaries entering the river from the east. That part of the basin lying north and west of the Grand is much less extensive in area, is lower, and is generally broken and barren, and a considerable portion of the waters of its streams is diverted for irrigation.

The geological formations of the basin range from the granite and masses of igneous origin on the crest of the Continental Divide to the younger and less resistant sedimentary rocks of the plateau region. The soils of the upper basin, though shallow, generally contain considerable organic matter; those of the intermediate basin are largely decomposed and disintegrated sedimentary rocks. in the lower basin the soils consist of adobe clays and sandy loams, which grade imperceptibly from one to the other. The scant vegetation of the lower basin renders soil erosion large.

The mountainous portion of the basin is still well covered with forests of spruce, quaking aspen, cedar, and pinon, and the forestation of the intermediate basin is fair. The controlling vegetation of the lower basin is sagebrush, chico, and cactus pads, with scattered pines, cedars, and pinons.

The precipitation ranges from 5 to 10 inches in the lower basin, 10 to 20 inches in the intermediate region, and 20 to 30 inches in the headwater region. By far the greater part of this is in the form of snow.

Natural storage within the basin is limited to a few small, high, mountain lakes. The stream channels of the upper basin are bordered to some extent by flat bottom lands, which are used as meadows and which are irrigated by a large number of small ditches. In the intermediate basin are a few small reservoirs storing snow and flood waters. A number of pumping plants also draw upon this district. Irrigation is extensively practiced in the Uncompahgre, Gunnison, and Grand valleys, and a large project now under construction by the Reclamation Service will require 1,200 second-feet of the discharge of Gunnison River. The immense power possibilities of the Grand are at present but little developed.

## NORTH FORK OF GRAND RIVER NEAR GRAND LAKE, COLO.

This station was established July 29, 1904. It is located at the highway bridge between Grand Lake and Hot Sulphur Springs, Colo., about 3 miles southwest of Grand Lake post-office, in T. 3 N., R. 76 W. The nearest railroad station is at Granby, on the Denver, Northwestern and Pacific, 15 miles distant.

The channel is straight for about 500 feet above and for 150 feet below the station. Both banks are about 2 feet high and are covered with heavy sod, willows, and scattered pine trees. The ground slopes upward from the top of the banks rather abruptly, so that even at very high stages the overflow is confined to a comparatively narrow channel. The bed of the stream at the station and for a considerable distance above and below is covered with large bowlders, which at high water cause a boiling and wave motion and at low stages eddies and in some places dead water. The channel is very rough and has a great fall. There is but one channel at all stages. The ordinary range of gage heights is about 3 feet. Gage readings are impracticable during the winter months owing to the formation of ice at the rod. The section is not entirely satisfactory, but it is the best available.

Discharge measurements are made at the higher stages from the downstream side of the single-span wooden bridge to which the gage is attached. The initial point for soundings is a 10-penny nail driven into the bridge floor over the north face of the right abutment and marked zero with black paint.

The gage, which was read twice each day during 1905 by G. W. Carr, is a staff attached vertically to the downstream edge of the right abutment of the bridge. The gage reads from 2 to 10.3 feet, the 2-foot mark resting on the bed of the stream. The bench mark is a 10-penny nail driven into a notch cut in the northeast root of a 12-inch pine tree which stands at the right end of the bridge on the downstream side; elevation, 8.36 feet above the zero of the gage. The elevation of the station above sea level is about 8,400 feet.

A description of this station with gage-heights and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 130-132.

*Discharge measurements of North Fork of Grand River near Grand Lake, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 5 | W. A. Lamb | 39 | 80 | 1.80 | 4.10 | 144 |
| May 30 | do | 43 | 122 | 3.47 | 4.80 | 423 |
| June 11 | do | 53 | 159 | 4.99 | 5.60 | 793 |
| June 30 | do | 52 | 137 | 4.20 | 5.20 | 576 |
| July 7 | do | 39 | 99 | 3.08 | 4.60 | 305 |
| July 26 | do | 39 | 87 | 1.59 | 4.15 | 138 |
| August 2 | do | 39 | 80 | 1.28 | 4.00 | 102 |
| August 16 | do | 39 | 63 | 1.02 | 3.76 | 64 |
| September 9 | do | 38 | 55 | .75 | 3.60 | 41 |
| September 18 | do | 38 | 49 | .65 | 3.49 | 32 |

*Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1905.*

| Day. | Apr. | May | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 4.38 | 5.2 | 5.05 | 4.02 | 3.58 | 3.55 | 3.48 | 4.28 |
| 2 | 3.3 | 4.4 | 5.22 | 5.05 | 4.0 | 3.6 | 3.52 | 3.5 | 3.45 |
| 3 | 3.3 | 4.3 | 5.4 | 4.95 | 3.98 | 3.62 | 3.5 | 3.62 | 3.4 |
| 4 | 3.3 | 4.2 | 5.8 | 4.7 | 3.98 | 3.68 | 3.5 | 3.68 | 3.38 |
| 5 | 3.3 | 4.08 | 5.8 | 4.6 | 3.92 | 3.62 | 3.5 | 3.6 | 3.4 |
| 6 | 3.35 | 3.95 | 5.78 | 4.6 | 3.9 | 3.6 | 3.48 | 3.58 | 3.88 |
| 7 | 3.3 | 4.12 | 5.8 | 4.55 | 3.88 | 3.6 | 3.45 | 3.48 | 3.8 |
| 8 | 3.3 | 4.28 | 5.88 | 4.62 | 3.82 | 3.58 | 3.45 | 3.35 | 3.4 |
| 9 | 3.35 | 4.35 | 6.2 | 4.6 | 3.8 | 3.55 | 3.48 | 3.38 | 3.38 |
| 10 | 3.3 | 4.25 | 6.1 | 4.58 | 3.8 | 3.55 | 3.48 | 3.45 | 3.85 |
| 11 | 3.3 | 4.12 | 5.6 | 4.58 | 3.82 | 3.55 | 3.5 | 3.5 | 3.65 |
| 12 | 3.35 | 4.1 | 5.7 | 4.5 | 4.02 | 3.5 | 3.5 | 3.5 | ........ |
| 13 | 3.4 | 4.15 | 5.85 | 4.55 | 3.98 | 3.5 | 3.5 | 3.45 | ........ |
| 14 | 3.4 | 4.1 | 5.7 | 4.52 | 3.85 | 3.5 | 3.5 | 3.5 | ........ |
| 15 | 3.4 | 4.1 | 5.75 | 4.62 | 3.8 | 3.48 | 3.5 | 3.45 | ........ |
| 16 | 3.4 | 4.3 | 5.85 | 4.58 | 3.78 | 3.48 | 3.5 | 3.35 | ........ |
| 17 | 3.42 | 4.6 | 5.68 | 4.52 | 3.72 | 3.45 | 3.5 | 3.38 | ........ |
| 18 | 3.5 | 4.72 | 5.45 | 4.45 | 3.7 | 3.5 | 3.48 | 3.4 | ........ |
| 19 | 3.48 | 4.75 | 5.35 | 4.3 | 3.7 | 3.52 | 3.42 | 3.55 | ........ |
| 20 | 3.5 | 4.8 | 5.2 | 4.3 | 3.68 | 3.5 | 3.52 | 3.5 | ........ |
| 21 | 3.52 | 4.88 | 5.3 | 4.32 | 3.65 | 3.5 | 3.65 | 3.45 | ........ |
| 22 | 3.52 | 4.95 | 5.3 | 4.22 | 3.62 | 3.5 | 3.68 | 3.4 | ........ |

*Daily gage height, in feet, of North Fork of Grand River near Grand Lake, Colo., for 1905—Continued.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 23 | 3.55 | 5.1 | 5.38 | 4.15 | 3.6 | 3.48 | 3.62 | 3.4 | ........ |
| 24 | 3.58 | 5.02 | 5.65 | 4.15 | 3.6 | 3.45 | 3.6 | 3.5 | ........ |
| 25 | 3.6 | 4.92 | 5.75 | 4.18 | 3.6 | 3.5 | 3.52 | 3.52 | ........ |
| 26 | 3.62 | 4.88 | 5.7 | 4.12 | 3.6 | 3.5 | 3.5 | 3.55 | ........ |
| 27 | 3.75 | 4.92 | 5.7 | 4.15 | 3.6 | 3.48 | 3.5 | 3.45 | ........ |
| 28 | 3.92 | 4.95 | 5.55 | 4.15 | 3.6 | 3.45 | 3.5 | 3.4 | ........ |
| 29 | 4.02 | 4.88 | 5.42 | 4.1 | 3.68 | 3.45 | 3.5 | 3.4 | ........ |
| 30 | 4.15 | 4.85 | 5.35 | 4.1 | 3.62 | 3.52 | 3.48 | 3.5 | ........ |
| 31 | ........ | 5.05 | ........ | 4.05 | 3.6 | ........ | 3.45 | ........ | ........ |

NOTE.—Ice conditions during December.

*Station rating table for North Fork of Grand River near Grand Lake, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.30 | 17 | 4.10 | 130 | 4.90 | 434 | 5.70 | 861 |
| 3.40 | 24 | 4.20 | 160 | 5.00 | 479 | 5.80 | 927 |
| 3.50 | 33 | 4.30 | 194 | 5.10 | 526 | 5.90 | 996 |
| 3.60 | 43 | 4.40 | 230 | 5.20 | 575 | 6.00 | 1,067 |
| 3.70 | 55 | 4.50 | 267 | 5.30 | 627 | 6.10 | 1,141 |
| 3.80 | 69 | 4.60 | 306 | 5.40 | 681 | 6.20 | 1,220 |
| 3.90 | 85 | 4.70 | 347 | 5.50 | 738 | | |
| 4.00 | 105 | 4.80 | 390 | 5.60 | 798 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 3.5 feet and 5.6 feet.

*Estimated monthly discharge of North Fork of Grand River near Grand Lake, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 145 | 17 | 35.8 | 2,130 |
| May | 526 | 95 | 291 | 17,890 |
| June | 1,220 | 575 | 816 | 48,560 |
| July | 502 | 118 | 254 | 15,620 |
| August | 110 | 43 | 67.5 | 4,150 |
| September | 53 | 28 | 35.7 | 2,124 |
| October | 53 | 26 | 34.2 | 2,103 |
| November | 53 | 20 | 31.1 | 1,851 |
| The period | .......... | .......... | .......... | 94,430 |

## GRAND LAKE OUTLET AT GRAND LAKE, COLO.

This station was established July 31, 1904. It is located at the footbridge at the west end of Grand Lake, about one-half mile south of Grand Lake post-office, Colo., in sec. 6, T. 3 N., R. 75 W. The nearest railroad station is 18 miles distant, at Granby, on the Denver, Northwestern and Pacific Railway.

The channel is straight for about 300 feet above and for 150 feet below the boat station. Both banks are about 3 feet high, and their level tops are covered with white pine trees. The stream does not overflow at this point, which is one-fourth mile below the gage and outlet. The current is swift at high water and medium at lower stages. The bed of the stream is composed of gravel and cobblestones and is firm and free from vegetation. At the gage both banks are low and are liable to overflow. There is but one channel at all stages. Gage heights have an ordinary range of 2.5 feet. Ice conditions render gage readings impracticable during the winter months.

High-water measurements are made from a boat at a ford about one-fourth mile below the gage. Points for soundings are marked at 5-foot intervals by tin tags fastened to a wire stretched across the stream 50 feet above the ford. The initial point for soundings is the tree to which the wire is fastened on the right bank. At ordinary and low stages measurements are made by wading at convenient points below the gage.

The gage, which was read twice each day during 1905 by J. W. Davies, is a staff attached vertically to the southeast corner of the second pier from the north end of the footbridge, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows: (1) A cross on the top of a large granite bowlder 85 feet south of the left bank of the outlet and 40 feet west of the lake, marked with black paint "U. S. G. S. B. M." elevation, 12.05 feet above the zero of the gage. (2) A cross cut in the top of a granite bowlder 1,198 feet north from the initial point for soundings and marked "B. M.;" elevation, 14.93 feet above the zero of the gage. Elevation above sea level is about 8,500 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 132–134.

*Discharge measurements of Grand Lake Outlet at Grand Lake, Colo., in 1905.*

| Date. | Hydrographer. | Width | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 4 | Wm. A. Lamb | 48 | 49 | 1.53 | 2.00 | 75 |
| May 31 | do | 56 | 105 | 3.28 | 2.90 | 345 |
| June 11 | do | 170 | 347 | 2.39 | 3.88 | 830 |
| July 1 | do | 156 | 275 | 2.13 | 3.42 | 585 |
| July 8 | do | 151 | 222 | 1.39 | 2.77 | 308 |
| July 27 | do | 120 | 137 | 1.34 | 2.42 | 184 |
| August 3 | do | 126 | 124 | 1.07 | 2.21 | 133 |
| August 17 | do | 49 | 47 | 1.40 | 1.95 | 66 |
| September 11 | do | 36 | 34 | .82 | 1.62 | 28 |
| September 18 | do | 36 | 30 | .57 | 1.50 | 17 |

NOTE.—Measurements made at different sections.

*Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 1.34 | 1.92 | 3.22 | 3.37 | 2.34 | 1.76 | 1.48 |
| 2 | 1.36 | 2.02 | 3.46 | 3.24 | 2.28 | 1.74 | 1.48 |
| 3 | 1.38 | 2.04 | 3.64 | 3.01 | 2.22 | 1.62 | 1.48 |
| 4 | 1.39 | 2.0 | 3.98 | 2.82 | 2.19 | 1.66 | 1.48 |
| 5 | 1.39 | 1.96 | 4.18 | 2.74 | 2.16 | 1.68 | 1.48 |
| 6 | 1.39 | 1.9 | 4.03 | 2.71 | 2.13 | 1.68 | 1.47 |
| 7 | 1.39 | 1.85 | 4.02 | 2.7 | 2.1 | 1.69 | 1.45 |
| 8 | 1.39 | 1.84 | 4.11 | 2.74 | 2.06 | 1.7 | 1.43 |
| 9 | 1.4 | 1.92 | 4.44 | 2.72 | 2.03 | 1.68 | 1.42 |
| 10 | 1.48 | 1.96 | 4.21 | 2.71 | 2.0 | 1.66 | 1.4 |
| 11 | 1.52 | 1.96 | 3.9 | 2.75 | 2.0 | 1.65 | 1.39 |

*Daily gage height, in feet, of Grand Lake Outlet at Grand Lake, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 12 | 1.54 | 1.92 | 3.9 | 2.78 | 2.06 | 1.62 | 1.38 |
| 13 | 1.54 | 1.9 | 4.0 | 2.75 | 2.08 | 1.59 | 1.37 |
| 14 | 1.54 | 1.9 | 3.9 | 2.74 | 2.06 | 1.58 | 1.38 |
| 15 | 1.56 | 1.87 | 3.98 | 2.76 | 2.04 | 1.54 | 1.39 |
| 16 | 1.56 | 1.86 | 4.12 | 2.76 | 2.0 | 1.54 | 1.4 |
| 17 | 1.57 | 1.96 | 3.72 | 2.68 | 1.94 | 1.52 | 1.42 |
| 18 | 1.57 | 2.12 | 3.69 | 2.62 | 1.9 | 1.5 | 1.44 |
| 19 | 1.58 | 2.24 | 3.46 | 2.56 | 1.86 | 1.49 | 1.45 |
| 20 | 1.62 | 2.36 | 3.32 | 2.56 | 1.84 | 1.49 | 1.46 |
| 21 | 1.62 | 2.48 | 3.4 | 2.54 | 1.82 | 1.49 | 1.44 |
| 22 | 1.63 | 2.66 | 3.38 | 2.52 | 1.8 | 1.48 | 1.44 |
| 23 | 1.64 | 2.94 | 3.46 | 2.47 | 1.78 | 1.47 | 1.42 |
| 24 | 1.64 | 3.06 | 3.66 | 2.42 | 1.78 | 1.46 | 1.42 |
| 25 | 1.64 | 2.96 | 3.76 | 2.4 | 1.78 | 1.44 | 1.42 |
| 26 | 1.64 | 2.88 | 3.87 | 2.42 | 1.8 | 1.44 | 1.43 |
| 27 | 1.66 | 2.9 | 3.84 | 2.43 | 1.79 | 1.44 | 1.43 |
| 28 | 1.72 | 2.97 | 3.74 | 2.41 | 1.8 | 1.44 | 1.43 |
| 29 | 1.76 | 2.89 | 3.66 | 2.41 | 1.8 | 1.45 | 1.44 |
| 30 | 1.82 | 2.8 | 3.56 | 2.42 | 1.8 | 1.48 | 1.47 |
| 31 | ........ | 2.9 | ........ | 2.38 | 1.8 | ........ | 1.46 |

*Station rating table for Grand Lake Outlet at Grand Lake, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 10 | 2.20 | 122 | 3.10 | 433 | 4.00 | 900 |
| 1.40 | 13 | 2.30 | 148 | 3.20 | 479 | 4.10 | 956 |
| 1.50 | 18 | 2.40 | 176 | 3.30 | 527 | 4.20 | 1,013 |
| 1.60 | 25 | 2.50 | 207 | 3.40 | 578 | 4.30 | 1,071 |
| 1.70 | 34 | 2.60 | 240 | 3.50 | 630 | 4.40 | 1,130 |
| 1.80 | 46 | 2.70 | 275 | 3.60 | 682 | 4.50 | 1,190 |
| 1.90 | 60 | 2.80 | 312 | 3.70 | 735 | | |
| 2.00 | 77 | 2.90 | 350 | 3.80 | 789 | | |
| 2.10 | 98 | 3.00 | 390 | 3.90 | 844 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and is well defined.

*Estimated monthly discharge of Grand Lake Outlet at Grand Lake, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 49 | 11 | 22.7 | 1,351 |
| May | 416 | 52 | 168. | 10,330 |
| June | 1,154 | 489 | 785 | 46,710 |
| July | 563 | 170 | 267 | 16,420 |
| August | 159 | 44 | 76.2 | 4,685 |
| September | 41 | 15 | 23.7 | 1,410 |
| October | 17 | 12 | 14.7 | 904 |
| The period | ........ | ........ | ........ | 81,810 |

## NORTH INLET TO GRAND LAKE AT GRAND LAKE, COLO.

This station was established August 3, 1905. It is located at the footbridge which crosses the stream about 100 yards north of the mouth and 300 yards east of Grand Lake post-office, in sec. 5, T. 3 N., R. 75 W.

The channel is straight for 300 feet above and for 200 feet below the station. The right bank is low, is covered with grasses and scattered willows and white pine trees, and at high stages overflows to a considerable extent. The left bank is high and is covered with a dense growth of white pines and underbrush. The bed of the stream is composed of large cobblestones and gravel and is permanent. There is but one channel at all ordinary stages, broken by the middle pier of the bridge. The current is swift at high and medium at low water.

High-water measurements are made from the upstream side of the two-span footbridge. The initial point for soundings is a 40-penny nail driven in the top of the west end of the north stringer of the bridge, 97 feet from bench mark No. 2. The point is marked with black paint. Low-water measurements are made by wading at convenient points above the bridge.

The gage, which was read twice each day during 1905 by J. Cairns, is a 4-foot timber fastened to the west face of the outer pier of the bridge. It is referred to bench marks as follows: (1) A 40-penny nail driven horizontally in the west face of a white pine tree 8 inches in diameter located on the left bank of the stream, 20 feet northeast of the east end of the bridge, marked "U. S. B. M.;" elevation, 5.32 feet above the zero of the gage. (2) A 40-penny nail driven horizontally in the east face of a white pine tree 1 foot in diameter located on the right bank of the stream 97 feet west of the initial point for soundings; elevation, 4.43 feet above the zero of the gage.

*Discharge measurements of North Inlet to Grand Lake at Grand Lake, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 4 | W. A. Lamb | 48 | 43 | 1.37 | 2.30 | 58 |
| May 31 | do | 50 | 111 | 1.84 | 3.05 | 204 |
| July 27 | do | 48 | 53 | 1.62 | 2.40 | 86 |
| August 3 | do | 46 | 50 | 1.36 | 2.30 | 68 |
| September 11 | do | 34 | 23 | .61 | 1.90 | 14 |
| September 18 | do | 30 | 15 | .63 | 1.85 | 9.4 |

NOTE.—Measurements made at different sections.

*Daily gage height, in feet, of North Inlet to Grand Lake at Grand Lake, Colo., for 1905.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|
| 1 | | 2.0 | 1.8 | 1.85 | 1.85 |
| 2 | | 2.0 | 1.8 | 1.85 | 1.8 |
| 3 | 2.3 | 1.9 | 1.8 | 1.85 | 1.8 |
| 4 | 2.3 | 1.9 | 1.8 | 1.85 | 1.8 |
| 5 | 2.3 | 1.9 | 1.8 | 1.9 | 1.8 |
| 6 | 2.3 | 1.9 | 1.8 | 1.9 | 1.8 |
| 7 | 2.3 | 2.0 | 1.8 | 1.9 | 1.8 |
| 8 | 2.2 | 1.9 | 1.8 | 1.9 | 1.8 |
| 9 | 2.2 | 1.9 | 1.8 | 1.9 | 1.8 |
| 10 | 2.2 | 1.9 | 1.8 | 1.9 | 1.8 |
| 11 | 2.2 | 1.9 | 1.8 | 1.9 | 1.8 |
| 12 | 2.2 | 1.9 | 1.8 | 1.9 | 1.8 |
| 13 | 2.2 | 1.9 | 1.8 | 1.9 | 1.9 |
| 14 | 2.2 | 1.9 | 1.8 | 1.9 | 1.9 |
| 15 | 2.15 | 1.9 | 1.8 | 1.9 | 1.9 |
| 16 | 2.1 | 1.9 | 1.8 | 1.9 | 1.9 |
| 17 | 2.1 | 1.9 | 1.8 | 1.9 | 1.8 |
| 18 | 2.1 | 1.9 | 1.8 | 1.9 | 1.8 |
| 19 | 2.0 | 1.9 | 1.8 | 1.9 | 1.8 |
| 20 | 2.0 | 1.9 | 1.85 | 1.9 | 1.8 |
| 21 | 2.0 | 1.9 | 1.95 | 1.9 | 1.8 |
| 22 | 2.0 | 1.9 | 1.9 | 1.9 | 1.8 |
| 23 | 2.0 | 1.9 | 1.9 | 1.9 | 1.8 |
| 24 | 2.0 | 1.8 | 1.9 | 1.9 | 1.8 |
| 25 | 2.0 | 1.8 | 1.85 | 1.9 | 1.8 |
| 26 | 2.0 | 1.8 | 1.85 | 1.9 | 1.8 |
| 27 | 2.0 | 1.8 | 1.8 | 1.9 | 1.8 |
| 28 | 2.0 | 1.8 | 1.8 | 1.9 | 1.8 |
| 29 | 2.0 | 1.8 | 1.85 | 1.9 | 1.8 |
| 30 | 2.0 | 1.8 | 1.9 | 1.9 | 1.8 |
| 31 | 2.0 | ...... | 1.95 | ...... | 1.8 |

## GRAND RIVER AT HOT SULPHUR SPRINGS, COLO.

This station was established July 27, 1904. It is located at the highway bridge one-eighth mile below Hot Sulphur Springs, Colo., in sec. 3, T. 1 N., R. 78 W., and is 5 miles above the mouth of Williams Fork River.

The channel is straight for about 200 feet below the station. Above the station it is curved at almost a right angle. Both banks are high and can not overflow. The bed of the stream is composed of bed rock, heavy gravel, and large bowlders on the right side, while on the left side it is a sloping gravel bar extending outward to the left abutment of the bridge. It is free from vegetation and, except for the gravel bar, is permanent. There is but one channel at all stages broken by the two piers of the bridge. The current is swift and at low water passes under the bridge squarely. At high water the current in the greater part of the section passes under the bridge at an angle. The accuracy of measurements is affected by the boiling of the water at the piers and by the large bowlders in the channel beneath the bridge. During the spring and early summer of 1905 the channel 100 feet below the station was somewhat obstructed by large bowlders which were blasted from a railroad cut on the right bank. This obstruction backs the water up on the gage to a considerable extent and at extreme low stages causes dead water in a portion of the cross sections.

Discharge measurements, except at very low stages, are made from the upstream side of the three-span bridge. The initial point for soundings is located over the inner face of the right abutment and is marked with a circle on the upstream hub rail. A stay line is located 30 feet above the bridge.

The gage, which was read once each day during 1905 by Mrs. Carrie Wills, consists of a vertical staff, bolted vertically to the downstream end of the first pier from the right bank. The gage reads from 2 to 10.8 feet, the 2-foot mark resting on bed rock. The gage is referred to bench marks as follows: (1) A cross painted on the north pier above the gage rod; elevation, 16.48 feet above the zero of the gage. (2) A cross cut in the top of a bench on the northwest face of a sandstone cliff on the east side of the road 50 feet south of the bridge; elevation, 25.49 feet above the zero of the gage. The elevation of the station above sea level is approximately 6,550 feet.

A description of this station and gage-height and discharge data are contained in Water-Supply Paper, No. 133, United States Geological Survey, pages 135–137.

*Discharge measurements of Grand River at Hot Sulphur Springs, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 1 | W. A. Lamb | 80 | 401 | 3.16 | 5.22 | 1,269 |
| May 6 | do | 66 | 333 | 2.14 | 4.40 | 722 |
| May 29 | do | 97 | 517 | 5.10 | 6.55 | 2,638 |
| June 3 | do | 106 | 665 | 6.27 | 7.85 | 4,167 |
| June 9 | do | 102 | 782 | 7.33 | 9.15 | 5,733 |
| July 5 | do | 74 | 446 | 3.46 | 5.52 | 1,542 |
| July 25 | do | 70 | 359 | 2.10 | 4.58 | 731 |
| August 16 | do | 63 | 269 | 1.28 | 3.95 | 343 |
| August 29 | do | 58 | 279 | .99 | 3.74 | 277 |
| September 9 | do | 58 | 284 | .99 | 3.60 | 281 |
| September 15 | do | 54 | 250 | .81 | 3.45 | 203 |
| October 2 | do | 54 | 251 | .73 | 3.43 | 183 |

*Daily gage height, in feet, of Grand River at Hot Sulphur Springs, Colo., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.65 | 2.9 | 5.35 | 7.4 | 6.75 | 4.55 | 3.35 | 3.5 | 3.45 |
| 2 | 2.7 | 2.95 | 5.58 | 7.55 | 6.35 | 4.6 | 3.3 | 3.5 | 3.45 |
| 3 | 2.7 | 2.75 | 5.38 | 7.8 | 6.1 | 4.6 | 3.4 | 3.5 | 3.45 |
| 4 | 2.68 | 2.65 | 4.98 | 8.5 | 6.0 | 4.45 | 3.4 | 3.4 | 3.5 |
| 5 | 2.68 | 2.75 | 4.8 | 8.95 | 5.45 | 4.3 | 3.32 | 3.4 | 3.5 |
| 6 | 2.68 | 2.8 | 4.58 | 8.4 | 5.45 | 4.3 | 3.32 | 3.4 | 3.5 |
| 7 | 2.68 | 3.0 | 4.7 | 8.5 | 5.45 | 4.25 | 3.4 | 3.4 | 3.5 |
| 8 | 2.68 | 3.15 | 4.8 | 9.05 | 5.42 | 4.2 | 3.4 | 3.4 | 3.5 |
| 9 | 2.7 | 3.4 | 5.2 | 8.75 | 5.42 | 4.22 | 3.32 | 3.4 | 3.5 |
| 10 | 2.65 | 3.6 | 4.98 | 8.25 | 5.45 | 4.28 | 3.3 | 3.4 | 3.48 |
| 11 | 2.65 | 3.58 | 4.78 | 8.25 | 5.42 | 4.2 | 3.32 | 3.4 | 3.45 |
| 12 | 2.65 | 3.62 | 4.7 | 8.25 | 5.42 | 4.05 | 3.3 | 3.4 | 3.42 |
| 13 | 2.65 | 3.58 | 4.8 | 8.0 | 5.42 | 4.0 | 3.32 | 3.42 | 3.42 |
| 14 | 2.68 | 3.55 | 4.62 | 8.05 | 5.42 | 4.0 | 3.22 | 3.48 | 3.42 |
| 15 | 2.65 | 3.5 | 4.62 | 7.65 | 5.45 | 4.02 | 3.2 | 3.42 | 3.42 |
| 16 | 2.68 | 3.75 | 4.88 | 7.55 | 5.22 | 4.08 | 3.2 | 3.4 | 3.42 |
| 17 | 2.7 | 3.6 | 5.45 | 7.65 | 5.18 | 3.95 | 3.0 | 3.4 | 3.4 |
| 18 | 2.65 | 3.78 | 5.85 | 7.88 | 5.05 | 3.92 | 3.0 | 3.4 | 3.4 |
| 19 | 2.65 | 4.02 | 6.15 | 7.85 | 5.02 | 3.9 | 3.4 | 3.4 | 3.4 |
| 20 | 2.7 | 3.95 | 6.38 | 7.4 | 4.98 | 3.88 | 3.5 | 3.4 | ........ |
| 21 | 2.65 | 3.8 | 6.48 | 7.4 | 4.9 | 3.85 | 3.4 | 3.4 | ........ |
| 22 | 2.7 | 3.88 | 6.72 | 7.45 | 4.75 | 3.8 | 3.4 | 3.4 | ........ |
| 23 | 2.7 | 3.95 | 7.05 | 7.1 | 4.58 | 3.78 | 3.4 | 3.4 | ........ |
| 24 | 2.65 | 4.22 | 7.12 | 7.15 | 4.45 | 3.75 | 3.4 | 3.4 | ........ |
| 25 | 2.7 | 4.05 | 6.75 | 7.5 | 4.42 | 3.58 | 3.4 | 3.4 | ........ |
| 26 | 2.7 | 4.08 | 6.62 | 7.45 | 4.42 | 3.45 | 3.4 | 3.4 | ........ |
| 27 | 2.65 | 4.48 | 6.75 | 7.5 | 4.46 | 3.4 | 3.4 | 3.45 | ........ |
| 28 | 2.75 | 4.62 | 6.85 | 7.55 | 4.46 | 3.4 | 3.4 | 3.45 | ........ |
| 29 | 2.75 | 4.65 | 6.6 | 7.4 | 4.46 | 3.42 | 3.4 | 3.45 | ........ |
| 30 | 2.8 | 4.88 | 6.48 | 7.1 | 4.6 | 3.38 | 3.48 | 3.45 | ........ |
| 31 | 2.85 | ........ | 6.6 | ........ | 4.6 | 3.4 | ........ | 3.45 | ........ |

*Station rating table for Grand River at Hot Sulphur Springs, Colo., from July 27, 1904, to April 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.60 | 185 | 2.90 | 276 | 3.20 | 402 | 3.50 | 554 |
| 2.70 | 215 | 3.00 | 313 | 3.30 | 450 | 3.60 | 609 |
| 2.80 | 245 | 3.10 | 355 | 3.40 | 501 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1904 and is well defined.

*Station rating table for Grand River at Hot Sulphur Springs, Colo., from May 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.00 | 95 | 4.20 | 500 | 5.40 | 1,430 | 7.20 | 3,360 |
| 3.10 | 110 | 4.30 | 560 | 5.50 | 1,530 | 7.40 | 3,600 |
| 3.20 | 130 | 4.40 | 620 | 5.60 | 1,630 | 7.60 | 3,840 |
| 3.30 | 150 | 4.50 | 680 | 5.70 | 1,730 | 7.80 | 4,080 |
| 3.40 | 180 | 4.60 | 750 | 5.80 | 1,830 | 8.00 | 4,320 |
| 3.50 | 210 | 4.70 | 820 | 5.90 | 1,930 | 8.20 | 4,560 |
| 3.60 | 240 | 4.80 | 900 | 6.00 | 2,030 | 8.40 | 4,800 |
| 3.70 | 280 | 4.90 | 980 | 6.20 | 2,250 | 8.60 | 5,040 |
| 3.80 | 320 | 5.00 | 1,060 | 6.40 | 2,470 | 8.80 | 5,280 |
| 3.90 | 360 | 5.10 | 1,150 | 6.60 | 2,690 | 9.00 | 5,540 |
| 4.00 | 400 | 5.20 | 1,240 | 6.80 | 2,910 | 9.20 | 5,800 |
| 4.10 | 450 | 5.30 | 1,330 | 7.00 | 3,130 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on twelve discharge measurements made during 1905. It is well defined above gage height 3.4 feet. Owing to changing conditions from April 15 to April 30 the above table has been applied indirectly for that period.

*Estimated monthly discharge of Grand River at Hot Sulphur Springs, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 260 | 200 | 212 | 13,040 |
| April | 1,036 | 200 | 550 | 32,730 |
| May | 3,264 | 736 | 1,785 | 109,800 |
| June | 5,605 | 3,240 | 4,137 | 246,200 |
| July | 2,855 | 632 | 1,265 | 77,780 |
| August | 750 | 174 | 410 | 25,210 |
| September | 210 | 95 | 164 | 9,759 |
| October | 210 | 180 | 186 | 11,440 |
| November 1-19 | 210 | 180 | 195 | 7,349 |
| The period | | | | 533,300 |

## GRAND RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904. It is located at the mouth or upper end of Gore Canyon, about 3 miles southwest of Kremmling, Colo.

The channel is straight for about 100 feet above and for 150 feet below the station. The right bank is the grade of the Denver, Northwestern and Pacific Railway; the left bank is abrupt and is covered with bowlders and bushes; neither bank overflows. The bed of the stream is composed of sand, silt, and bowlders and is very shifting, the change in channel being as great as 10 feet in places. The channel scours out during high-water stages and gradually fills up again as the water subsides. There is but one channel at all stages. The current is very sluggish at low water and medium to swift at high water. Gage heights have a range of about 15 feet during an ordinary season. Gage readings in the winter months are somewhat affected by ice in the channel. The shifting of the bed makes the development of a good rating curve a difficult matter. The station is not entirely satisfactory, but it is the best location available below the mouth of Blue River.

Discharge measurements are made from a cable stretched across the river just below the gage and about 150 feet above the wagon bridge. The cable is approximately 280 feet long and is tagged with tin tags marked every 5 feet from the top of the right bank, which is a high sandstone cliff, to the top of the left bank. The initial point for soundings is the face of the rock to which the cable is anchored on the right bank.

Gage readings at this station were made twice each day during 1905 by J. C. Harper. The original equipment consisted of a wire gage attached to the cantilever arm of the frame to which the gage rod was spiked in a horizontal position. This gage was destroyed by high water in June, 1905, and after the water had subsided the old gage was placed on a new cantilever arm similar to the old one but about 3 feet higher, the gage datum remaining the same and the wire was replaced by a standard chain. The length of the chain is 36.50 feet. Bench mark No. 1 is a cross cut in the east face of a large bowlder on the right bank about 20 feet south of the cable marked with black paint "U.S. B.M.;" elevation, 25.03 feet above the zero of the gage. The elevation above sea level is about 7,250 feet. Bench mark No. 2 is a cross cut and painted block on top of a cone-shaped granite bowlder on the left bank of the river about 50 feet downstream from the gage. Elevation of bench mark above gage datum is 9.57 feet. This bench mark is submerged at high water.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 137–139.

*Discharge measurements of Grand River near Kremmling, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 28 | W. A. Lamb | 115 | 775 | 2.27 | 5.24 | 1,762 |
| May 10 | do | 118 | 1,190 | 1.97 | 6.48 | 2,344 |
| May 27 | do | 141 | 1,810 | 3.08 | 10.98 | 5,575 |
| June 6 | do | 160 | 2,688 | 4.24 | 15.14 | 11,400 |
| June 16 | do | 150 | 2,362 | 3.67 | 13.05 | 8,668 |
| June 18 | M. C. Hinderlider | 142 | 2,183 | 3.32 | 11.81 | 7,248 |
| June 27 | W. A. Lamb | 135 | 1,945 | 2.97 | 10.22 | 5,777 |
| July 13 | do | 106 | 1,293 | 1.49 | 5.80 | 1,927 |
| July 22 | do | 116 | 1,310 | 1.30 | 5.15 | 1,703 |
| August 10 | do | 104 | 920 | .93 | 3.10 | 852 |
| August 25 | do | 102 | 409 | 1.68 | 2.38 | 689 |
| September 5 | do | 104 | 380 | 1.72 | 2.29 | 655 |
| September 14 | do | 100 | 271 | 1.85 | 1.83 | 500 |
| September 27 | do | 101 | 202 | 2.09 | 1.60 | 423 |

*Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.41 | 0.95 | 1.09 | 2.08 | 6.88 | 11.83 | 8.81 | 4.54 | 2.90 | 1.90 | 1.32 | 0.92 |
| 2 | 1.36 | .97 | 1.06 | 2.21 | 7.50 | 12.42 | 8.33 | 4.27 | 2.48 | 1.75 | 1.23 | 1.15 |
| 3 | 1.18 | .95 | 1.14 | 2.03 | 7.22 | 12.92 | 8.04 | 3.99 | 2.16 | 1.85 | 1.58 | 1.06 |
| 4 | 1.01 | .95 | 1.09 | 1.53 | 6.50 | 14.03 | 7.40 | 3.88 | 2.22 | 1.70 | 1.88 | 1.13 |
| 5 | .98 | .93 | 1.06 | 1.65 | 5.98 | 15.42 | 6.76 | 3.70 | 2.32 | 1.68 | 1.92 | 1.18 |
| 6 | .94 | .97 | 1.16 | 2.08 | 5.40 | 15.25 | 6.61 | 3.72 | 2.40 | 1.65 | 1.97 | 1.06 |
| 7 | .88 | .85 | 1.19 | 2.68 | 5.22 | 14.46 | 6.34 | 3.76 | 2.52 | 1.54 | 1.82 | .75 |
| 8 | .76 | .93 | 1.14 | 2.61 | 5.35 | 14.66 | 6.32 | 3.32 | 2.46 | 1.50 | 1.68 | .82 |
| 9 | .78 | .83 | 1.16 | 2.93 | 6.40 | 15.28 | 6.21 | 3.38 | 2.34 | 1.50 | 1.56 | 1.26 |
| 10 | .98 | .75 | 1.09 | 3.31 | 6.38 | 15.43 | 5.48 | 3.18 | 2.26 | 1.46 | 1.44 | 1.60 |
| 11 | .96 | .84 | 1.14 | 3.38 | 6.45 | 14.45 | 5.46 | 3.15 | 2.14 | 1.24 | 1.20 | 1.90 |
| 12 | .88 | .80 | 1.16 | 3.25 | 6.54 | 13.46 | 5.90 | 3.56 | 2.02 | 1.36 | 1.21 | 1.64 |
| 13 | .88 | .95 | 1.22 | 3.33 | 5.65 | 13.54 | 5.87 | 3.76 | 1.90 | 1.42 | 1.32 | 1.90 |
| 14 | .86 | .95 | 1.24 | 3.35 | 5.68 | 13.45 | 5.76 | 3.44 | 1.84 | 1.56 | 1.60 | 1.72 |

*Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | .84 | .90 | 1.32 | 3.05 | 5.50 | 12.77 | 5.98 | 3.18 | 1.74 | 1.64 | 1.55 | 1.35 |
| 16 | .98 | 1.05 | 1.39 | 2.98 | 5.87 | 13.06 | 5.88 | 3.00 | 1.68 | 1.60 | 1.48 | 1.22 |
| 17 | .98 | 1.05 | 1.49 | 2.91 | 6.99 | 12.54 | 5.95 | 2.76 | 1.64 | 1.92 | 1.65 | 1.00 |
| 18 | 1.01 | 1.10 | 1.44 | 3.01 | 7.88 | 11.75 | 5.42 | 2.66 | 1.66 | 1.90 | 1.75 | 1.08 |
| 19 | 1.04 | 1.03 | 1.29 | 3.48 | 8.78 | 11.53 | 5.36 | 2.38 | 1.78 | 1.82 | 1.67 | .82 |
| 20 | .88 | .93 | 1.34 | 3.48 | 9.61 | 11.37 | 5.24 | 2.48 | 1.79 | 1.70 | 1.20 | .63 |
| 21 | .84 | 1.03 | 1.49 | 3.11 | 9.78 | 10.29 | 5.35 | 2.41 | 1.79 | 1.50 | 1.28 | .70 |
| 22 | .86 | 1.05 | 1.52 | 3.05 | 10.52 | 10.29 | 5.14 | 2.32 | 1.72 | 1.65 | 1.48 | .68 |
| 23 | .96 | 1.07 | 1.46 | 3.31 | 11.31 | 10.51 | 4.64 | 2.29 | 1.65 | 1.75 | 1.45 | .64 |
| 24 | 1.04 | 1.05 | 1.34 | 3.68 | 11.59 | 10.43 | 4.50 | 2.36 | 1.60 | 1.82 | 1.82 | .56 |
| 25 | .98 | 1.03 | 1.44 | 3.71 | 11.08 | 10.35 | 4.46 | 2.41 | 1.60 | 1.82 | 1.32 | .50 |
| 26 | .78 | 1.03 | 1.59 | 3.48 | 10.70 | 10.35 | 4.45 | 2.46 | 1.60 | 1.61 | 1.34 | .44 |
| 27 | .78 | 1.07 | 2.04 | 4.11 | 11.00 | 10.35 | 4.42 | 2.42 | 1.60 | 1.66 | 1.49 | .45 |
| 28 | .86 | 1.07 | 1.79 | 5.05 | 10.95 | 10.04 | 4.51 | 2.36 | 1.58 | 1.83 | 1.30 | .32 |
| 29 | .81 | ....... | 1.46 | 5.32 | 10.44 | 9.46 | 4.61 | 2.48 | 1.58 | 1.85 | 1.08 | .28 |
| 30 | .94 | ....... | 1.49 | 5.85 | 10.09 | 9.32 | 4.64 | 2.55 | 1.68 | 1.82 | .68 | .46 |
| 31 | .96 | ....... | 1.82 | ....... | 10.65 | ....... | 4.66 | 2.82 | ....... | 1.68 | ....... | .34 |

NOTE.—No ice record.

*Station rating table for Grand River near Kremmling, Colo., from January 1 to December 31, 1905.*[a]

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.20 | 220 | 1.60 | 440 | 3.00 | 830 | 5.80 | 1,950 |
| .30 | 230 | 1.70 | 465 | 3.20 | 900 | 6.00 | 2,050 |
| .40 | 240 | 1.80 | 490 | 3.40 | 970 | 6.20 | 2,170 |
| .50 | 250 | 1.90 | 515 | 3.60 | 1,040 | 6.40 | 2,290 |
| .60 | 260 | 2.00 | 540 | 3.80 | 1,110 | 6.60 | 2,410 |
| .70 | 275 | 2.10 | 565 | 4.00 | 1,180 | 6.80 | 2,530 |
| .80 | 290 | 2.20 | 590 | 4.20 | 1,250 | 7.00 | 2,670 |
| .90 | 305 | 2.30 | 620 | 4.40 | 1,330 | 7.20 | 2,810 |
| 1.00 | 320 | 2.40 | 650 | 4.60 | 1,410 | 7.40 | 2,950 |
| 1.10 | 340 | 2.50 | 680 | 4.80 | 1,490 | 7.60 | 3,090 |
| 1.20 | 360 | 2.60 | 710 | 5.00 | 1,570 | 7.80 | 3,250 |
| 1.30 | 380 | 2.70 | 740 | 5.20 | 1,650 | 8.00 | 3,410 |
| 1.40 | 400 | 2.80 | 770 | 5.40 | 1,750 | | |
| 1.50 | 420 | 2.90 | 800 | 5.60 | 1,850 | | |

[a] From May 14 to July 10, inclusive, the table was applied indirectly, owing to shifting conditions.

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 1.6 feet and 6.5 feet.

*Estimated monthly discharge of Grand River near Kremmling, Colo., for 1905.*

[Drainage area, 2,380 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 402 | 287 | 314 | 19,310 | 0.132 | 0.152 |
| February | 340 | 282 | 316 | 17,550 | .133 | .138 |
| March | 550 | 332 | 390 | 23,980 | .164 | .189 |
| April | 1,975 | 426 | 924 | 54,980 | .388 | .433 |
| May | 6,430 | 1,660 | 3,523 | 216,600 | 1.48 | 1.71 |
| June | 11,820 | 4,850 | 7,999 | 476,000 | 3.36 | 3.75 |
| July | 4,340 | 1,338 | 2,046 | 125,800 | .860 | .992 |
| August | 1,386 | 617 | 866 | 53,250 | .364 | .420 |
| September | 800 | 436 | 532 | 31,660 | .224 | .250 |
| October | 520 | 368 | 475 | 29,210 | .200 | .231 |
| November | 532 | 272 | 419 | 24,930 | .176 | .196 |
| December | 515 | 228 | 325 | 19,980 | .137 | .158 |
| The year | 11,820 | 228 | 1,511 | 1,093,000 | .635 | 8.62 |

## GRAND RIVER AT GLENWOOD SPRINGS, COLO.

This station is located in the mountains, midway between the Continental Divide and the Colorado-Utah boundary line, and just above the third large tributary of the Grand, which is called Roaring Fork.

A comparison of the miscellaneous discharge measurements made at the mouth of Roaring Fork, at Glenwood Springs, during 1903 and 1904, with the discharge of the Grand, at Glenwood Springs, shows that the volume of water being discharged by the Roaring Fork augments the volume of water which passes the Glenwood station by 50 per cent. While there is a moderate amount of irrigation of the first bottom lands from the tributaries above this point, relatively little of the run-off of the basin is used.

The station was established May 12, 1899, at the request of the Denver and Rio Grande Railroad Company. It was at first located at the railroad bridge, a quarter of a mile west of the depot and just above the mouth of Roaring Fork; but at the beginning of 1900 it was removed to a point near the electric-light works. The measuring section is located at the State Street Bridge, which crosses the river at the main thoroughfare of Glenwood Springs, and is about 10 feet below the point at which all discharge measurements from 1900 to 1904, inclusive, were made.

The channel at the cable section is straight for a distance of several hundred feet each way. The left bank is the Denver and Rio Grande Railroad embankment and is well protected by a concrete and dry rubble retaining wall. The right bank is a low wall composed of bowlders, without any binding material, and protects the grounds of the Hotel Colorado. At extremely high water these grounds have been flooded, but this is a rare occurrence. The bed of the stream is composed of bowlders and cobblestones and is permanent. A small amount of silt is deposited at low water, but it scours out in the spring and does not change the cross section materially. There is but one channel at all stages. At high water the current is swift, often reaching a velocity as high as 20 feet per second; at low water the current has a moderate velocity. Gage heights range from 2.5 to 12 feet.

Discharge measurements since May 16, 1905, have been made by means of a cable, car, and stay line 60 feet upstream, the cable being anchored to the piers of the State Street Bridge. Measurements from 1900 to 1904, inclusive, were made from the footway which crosses the stringers of the bridge below the roadway, about 10 feet above the present section. Plottings of old and new cross sections show no material difference.

Gage readings at this station are made by W. H. Richardson, the manager of the Glenwood Electric Light and Power Company, morning and evening each day during the entire year. The first gage was wire, but when the station was removed to the electric-light works a new gage rod was placed. This consisted of a light vertical staff, to the lower end of which was attached a wooden float, which rested on the surface of the water, standing in a well or box made of 6-inch boards. The bottom of this well connected with a small wooden flume extending out into the river, which allowed the water in the well to assume the level of the river surface. In July, 1902, this gage being in bad repair was replaced by an automatic water register, the site being the same as that of the old float gage. The register never worked satisfactorily and was later replaced by another float gage, using the same well and intake flume. The present gage consists of a copper float and counterweight connected with a silk line passing over pulleys so arranged that a rise of 1 foot of the river registers but one-half foot on the rod. By this arrangement the large rise and fall of the river is readily accommodated by a length of gage that would be impossible with a direct-reading gage. The gage rod proper consists of a light pine rod, 1 by 1 inch by 5 feet, securely fastened in a vertical position inside a small house in which the apparatus is located and which sets on top of the vertical well. A pointer attached to a counterweight slides along the gage rod and registers the rise and fall of the river. This gage has given entire satisfaction. The original basis for the installation of this gage and the method of correction since that time is the relation of the depth of water in the well to the gage reading. When the gage reads correctly the difference between the depth of water in the well and the gage reading is 2.25 feet. The bench mark established June 27, 1904, is a cross cut in the top of the foundation capstone of the power house directly in front of the gage house, east of the power-house door, and is indicated by the letters "B.M." cut in the vertical face of the foundation stone on which the bench mark is located. Elevation of bench mark above the datum of the gage is 17.77 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

**Description:** WS 37, pp 293-294; 50, pp 375-376; 66, p 92; 85, p 48; 100, pp 89-90; 133, pp 139-140.
**Discharge:** WS 37, p 294; 50, p 376; 85, p 49; 100, p 90; 133, p 140.
**Discharge, monthly:** Ann 22, iv, p 389; WS 75, p 174; 85, p 50; 100, p 92; 133, p 141.
**Gage heights:** WS 37, p 294; 50, p 376; 66, p 93; 85, p 49; 100, p 91; 133, p 140.
**Hydrographs:** Ann 22, iv, p 389; WS 75, p 174.
**Rating tables:** WS 52, p 520; 66, p 174; 85, p 50; 100, p 91; 133, p 141.

*Discharge measurements of Grand River at Glenwood Springs, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 28 | R. I. Meeker | 190 | 508 | 2.01 | 3.77 | 1,019 |
| May 16 | do | 200 | 871 | 4.01 | 5.50 | 3,496 |
| June 2 | do | 210 | 1,630 | 10.07 | 9.12 | 16,410 |
| June 5 | do | 215 | 1,983 | 13.91 | 10.70 | 27,580 |
| July 9 | do | 208 | 906 | 4.35 | 5.82 | 3,941 |
| July 10 | do | 208 | 904 | 4.28 | 5.78 | 3,871 |
| August 13 | do | 194 | 643 | 2.98 | 4.68 | 1,919 |
| September 26 | do | 185 | 486 | 2.35 | 3.95 | 1,142 |

*Daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.34 | 3.29 | 3.36 | 3.68 | 5.95 | 8.55 | 7.32 | 5.05 | 4.35 | 3.88 | 3.95 | 3.25 |
| 2 | 3.4 | 3.29 | 3.46 | 3.82 | 6.4 | 9.1 | 6.75 | 4.95 | 4.45 | 3.9 | 3.85 | 3.32 |
| 3 | 3.34 | 3.26 | 3.48 | 3.88 | 6.42 | 9.2 | 6.58 | 4.85 | 4.32 | 3.98 | 3.88 | 3.25 |
| 4 | 3.4 | 3.24 | 3.56 | 3.78 | 6.12 | 9.9 | 6.45 | 4.82 | 4.35 | 3.95 | 3.85 | 3.35 |
| 5 | 3.44 | 3.24 | 3.61 | 3.72 | 5.85 | 10.7 | 6.15 | 4.72 | 4.32 | 3.92 | 3.98 | 3.38 |
| 6 | 3.47 | 3.24 | 3.61 | 3.72 | 5.6 | 10.7 | 6.02 | 4.68 | 4.3 | 3.92 | 4.0 | 3.3 |
| 7 | 3.47 | 3.24 | 3.64 | 3.78 | 5.45 | 10.4 | 5.95 | 4.65 | 4.35 | 3.92 | 3.98 | 3.18 |
| 8 | 3.44 | 3.19 | 3.51 | 3.92 | 5.48 | 10.3 | 5.88 | 4.65 | 4.4 | 3.9 | 3.98 | 3.18 |
| 9 | 3.42 | 3.19 | 3.44 | 4.1 | 5.8 | 10.72 | 5.85 | 4.58 | 4.32 | 3.85 | 3.92 | 3.15 |
| 10 | 3.37 | 3.19 | 3.46 | 4.28 | 6.05 | 10.58 | 5.78 | 4.5 | 4.22 | 3.85 | 3.92 | 3.1 |
| 11 | 3.32 | 3.19 | 3.48 | 4.48 | 5.88 | 10.48 | 5.7 | 4.5 | 4.22 | 3.85 | 3.88 | 2.9 |
| 12 | 3.32 | 3.12 | 3.51 | 4.5 | 5.68 | 10.38 | 5.7 | 4.52 | 4.15 | 3.82 | 3.82 | 3.0 |
| 13 | 3.22 | 2.96 | 3.56 | 4.48 | 5.58 | 10.02 | 5.7 | 4.7 | 4.12 | 3.85 | 3.8 | 3.1 |
| 14 | 3.22 | 2.99 | 3.61 | 4.45 | 5.65 | 9.68 | 5.65 | 4.78 | 4.1 | 3.85 | 3.78 | 3.02 |
| 15 | 3.32 | 3.04 | 3.66 | 4.5 | 5.62 | 9.68 | 5.65 | 4.62 | 4.05 | 3.85 | 3.85 | 2.95 |
| 16 | 3.4 | 3.09 | 3.66 | 4.45 | 5.68 | 9.25 | 5.68 | 4.52 | 4.02 | 3.88 | 3.9 | 3.35 |
| 17 | 3.37 | 3.14 | 3.71 | 4.32 | 6.0 | 8.85 | 5.58 | 4.42 | 4.0 | 3.9 | 3.88 | 3.4 |
| 18 | 3.4 | 3.29 | 3.64 | 4.3 | 6.62 | 8.58 | 5.5 | 4.35 | 4.0 | 3.95 | 3.88 | 3.4 |
| 19 | 3.47 | 3.24 | 3.66 | 4.45 | 7.1 | 8.25 | 5.5 | 4.32 | 4.02 | 3.95 | 3.88 | 3.38 |
| 20 | 3.44 | 3.29 | 3.66 | 4.52 | 7.48 | 7.9 | 5.42 | 4.25 | 4.05 | 3.92 | 3.82 | 3.4 |
| 21 | 3.4 | 3.29 | 3.64 | 4.58 | 7.68 | 7.8 | 5.28 | 4.22 | 4.1 | 3.82 | 3.78 | 3.4 |
| 22 | 3.42 | 3.29 | 3.66 | 4.4 | 7.92 | 7.75 | 5.3 | 4.15 | 4.05 | 3.82 | 3.82 | 3.3 |
| 23 | 3.42 | 3.26 | 3.66 | 4.4 | 8.4 | 7.78 | 5.28 | 4.12 | 4.02 | 3.95 | 3.78 | 3.25 |
| 24 | 3.4 | 3.26 | 3.64 | 4.48 | 8.58 | 7.8 | 5.2 | 4.12 | 4.0 | 3.98 | 3.75 | 3.22 |
| 25 | 3.4 | 3.32 | 3.61 | 4.6 | 8.45 | 7.78 | 5.12 | 4.15 | 3.98 | 3.95 | 3.65 | 3.2 |
| 26 | 3.37 | 3.32 | 3.68 | 4.62 | 8.2 | 7.65 | 5.12 | 4.18 | 3.95 | 3.95 | 3.68 | 3.28 |
| 27 | 3.37 | 3.34 | 3.68 | 4.62 | 8.2 | 7.65 | 5.02 | 4.15 | 3.92 | 3.95 | 3.68 | 3.32 |
| 28 | 3.27 | 3.39 | 3.81 | 4.92 | 8.22 | 7.58 | 5.02 | 4.15 | 3.92 | 3.95 | 3.85 | 3.4 |
| 29 | 3.24 | ....... | 3.78 | 5.35 | 8.08 | 7.5 | 5.05 | 4.18 | 3.9 | 4.0 | 3.48 | 3.32 |
| 30 | 3.27 | ....... | 3.68 | 5.52 | 7.85 | 7.42 | 5.02 | 4.18 | 3.95 | 4.02 | 3.12 | 3.22 |
| 31 | 3.32 | ....... | 3.65 | ....... | 8.0 | ....... | 5.02 | 4.3 | ....... | 3.95 | ....... | 3.22 |

*Station rating table for Grand River at Glenwood Springs, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.90 | 530 | 4.40 | 1,640 | 5.90 | 4,000 | 7.80 | 9,380 |
| 3.00 | 570 | 4.50 | 1,760 | 6.00 | 4,210 | 8.00 | 10,210 |
| 3.10 | 610 | 4.60 | 1,880 | 6.10 | 4,420 | 8.20 | 11,110 |
| 3.20 | 660 | 4.70 | 2,010 | 6.20 | 4,640 | 8.40 | 12,090 |
| 3.30 | 710 | 4.80 | 2,150 | 6.30 | 4,860 | 8.60 | 13,160 |
| 3.40 | 770 | 4.90 | 2,290 | 6.40 | 5,090 | 8.80 | 14,350 |
| 3.50 | 830 | 5.00 | 2,440 | 6.50 | 5,330 | 9.00 | 15,660 |
| 3.60 | 900 | 5.10 | 2,590 | 6.60 | 5,580 | 9.20 | 17,030 |
| 3.70 | 970 | 5.20 | 2,740 | 6.70 | 5,840 | 9.40 | 18,410 |
| 3.80 | 1,050 | 5.30 | 2,890 | 6.80 | 6,110 | 9.60 | 19,800 |
| 3.90 | 1,130 | 5.40 | 3,050 | 6.90 | 6,390 | 9.80 | 21,200 |
| 4.00 | 1,220 | 5.50 | 3,220 | 7.00 | 6.670 | 10.00 | 22,600 |
| 4.10 | 1,320 | 5.60 | 3,400 | 7.20 | 7,260 | 10.20 | 24,020 |
| 4.20 | 1,420 | 5.70 | 3,590 | 7.40 | 7,910 | 10.40 | 25,440 |
| 4.30 | 1,530 | 5.80 | 3,790 | 7.60 | 8,620 | 10.60 | 26,860 |

**Note.**—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined between gage heights 3.5 feet and 10.7 feet.

*Estimated monthly discharge of Grand River at Glenwood Springs, Colo., for 1905.*

[Drainage area, 4,523 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 812 | 670 | 753 | 46,300 | 0.166 | 0.191 |
| February | 764 | 554 | 672 | 37,320 | .149 | .155 |
| March | 1,058 | 746 | 906 | 55,710 | .200 | .231 |
| April | 3,256 | 956 | 1,641 | 97,650 | .363 | .405 |
| May | 13,050 | 3,135 | 6,675 | 410,400 | 1.48 | 1.71 |
| June | 27,710 | 7,980 | 16,590 | 987,200 | 3.67 | 4.10 |
| July | 7,646 | 2,470 | 3,614 | 222,200 | .799 | .921 |
| August | 2,515 | 1,340 | 1,735 | 106,700 | .384 | .443 |
| September | 1,700 | 1,130 | 1,356 | 80,690 | .300 | .335 |
| October | 1,240 | 1,066 | 1,142 | 70,220 | .252 | .290 |
| November | 1,220 | 620 | 1,067 | 63,490 | .236 | .263 |
| December | 770 | 530 | 685 | 42,120 | .151 | .174 |
| The year | 27,710 | 530 | 3,070 | 2,220,000 | .679 | 9.22 |

## GRAND RIVER NEAR PALISADES, COLO.

This station was established April 9, 1902. It is located at the steel highway bridge at the point where the river enters Grand Valley, 2 miles above Palisades, in T. 11 S., R. 98 W., and is above all irrigating ditches supplying water to Grand Valley, with the exception of one pumping plant, which takes about 20 second-feet from the river one-fourth mile above the station.

The stream channel is straight for 600 feet both above and below the station. The right bank is high and rocky, is composed largely of bowlders, cobblestones, and gravel, and will not overflow. The left bank is somewhat lower and will overflow for a short distance, but only at extreme high water. It is composed primarily of bowlders covered with sand. Above the banks are narrow mesas merging into abrupt talus slopes capped by sandstone, which rise precipitously for several hundred feet. From station 70 to station 140 the bed of the stream is approximately level and is composed of solid sandstone. Below the surface of the water on each side of this clean portion of the channel are large fragments of sandstone and large lava bowlders. During low water a deposit of silt forms to a depth of about 1 foot in the deeper portion of the channel and also fills in the large interstices of the rough banks. At high water this deposit is scoured out. The depth of the water varies from 12 feet at low stages to 22 feet at extreme high stages. This unusual depth of water at the low stage is due to the retardation of flow caused by immense sandstone bowlders and detritus across the stream channel, about 1,500 feet below the station, at a point locally called the Narrows. As a result the low-water current is sluggish and there are considerable areas of dead or backwater along each side. At high water the current is moderate at the sides, increasing very rapidly toward the center of the stream, where velocities of 20 feet per second have been observed. There is but one channel at all stages. Surface ice forms across the channel during winter.

At the recently constructed suspension bridge at Palisades the channel is straight, wide, and of uniform depth, the bed is of cobblestones, and the stream current is even. Conditions at the suspension bridge are far superior to those at the highway bridge for high-water measurements, while the reverse is true for low-water measurements.

At low water discharge measurements are made from the downstream side of the single-span steel highway bridge, which is 212 feet between masonry abutments. The initial point for soundings is the edge of the capstone of the left masonry abutment. At high stages discharge measurements are made from the 320-foot suspension bridge at Palisades, the initial point for soundings being at the face of the left abutment.

The gage, which was observed twice daily during 1905 by S. M. Purdy, was originally of wire and was located on the downstream side near the center of the highway bridge. On April 5, 1904, the wire gage was replaced by a new chain gage. The zero of the chain gage is identical with the zero of the wire gage. The scale on the inside of the chain-gage box reads from 11.6 to 22.5 feet. The length of the chain is 21.27 feet. The bench mark is a point on the capstone on the downstream end of the approach abutment on right bank of river. It is marked with a circle cut about the point and the letters "B. M.;" elevation above the zero of the gage, 29.49 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, pp 46-47; 100, p 87; 133, p 142.
Discharge: 85, p 47; 100, p 88; 133, p 142.
Discharge, monthly: 85, p 48; 100, p 89; 133, p 144.
Gage heights: 85, p 47; 100, p 88; 133, p 143.
Rating tables: 85, p 48; 100, p 89; 133, p 143.

*Discharge measurements of Grand River near Palisades, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 29[a] | R. I. Meeker | 140 | 1,083 | 1.39 | 12.40 | 1,504 |
| June 3[a] | do | 222 | 2,767 | 9.00 | 20.25 | 24,900 |
| July 11[a] | do | 191 | 1,683 | 3.68 | 14.92 | 6,210 |
| August 12[b] | do | 270 | 774 | 3.49 | 13.30 | 2,699 |
| September 27[b] | do | 255 | 677 | 2.38 | 12.50 | 1,608 |

[a] Measured at gage. [b] Measured from suspension bridge.

*Daily gage height, in feet, of Grand River near Palisades, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 12.5 | 15.2 | 19.35 | 17.0 | 14.25 | 12.7 | 12.75 |
| 2 | 12.5 | 16.1 | 20.05 | 16.75 | 14.05 | 12.8 | 12.7 |
| 3 | 12.55 | 16.45 | 20.35 | 16.3 | 13.85 | 12.85 | 12.7 |
| 4 | 12.55 | 16.05 | 21.0 | 16.0 | 13.7 | 12.8 | 12.7 |
| 5 | 12.45 | 15.55 | 22.05 | 15.8 | 13.55 | 12.95 | 12.7 |
| 6 | 12.4 | 15.15 | 22.0 | 15.5 | 13.6 | 13.05 | 12.55 |
| 7 | 12.4 | 15.0 | 21.8 | 15.35 | 13.4 | 12.95 | 12.5 |
| 8 | 12.4 | 14.9 | 21.35 | 15.2 | 13.4 | 12.9 | 12.5 |
| 9 | 12.4 | 15.3 | 22.0 | 15.15 | 13.35 | 12.8 | 12.5 |
| 10 | 12.95 | 15.6 | 22.0 | 15.0 | 13.25 | 12.8 | 12.5 |
| 11 | 13.3 | 15.65 | 21.3 | 14.95 | 13.3 | 12.8 | 12.5 |
| 12 | 13.7 | 15.3 | 21.25 | 14.95 | 13.3 | 12.7 | 12.5 |
| 13 | 13.4 | 15.35 | 20.6 | 14.8 | 13.45 | 12.7 | 12.5 |
| 14 | 13.3 | 15.45 | 20.35 | 14.75 | 13.4 | 12.6 | 12.5 |
| 15 | 13.3 | 15.2 | 20.4 | 14.7 | 13.35 | 12.6 | 12.5 |
| 16 | 13.3 | 15.3 | 20.4 | 14.7 | 13.25 | 12.55 | 12.55 |
| 17 | 13.2 | 15.65 | 19.9 | 14.65 | 13.1 | 12.5 | 12.65 |
| 18 | 13.2 | 16.45 | 19.45 | 14.55 | 12.95 | 12.5 | 12.7 |
| 19 | 13.25 | 17.3 | 19.05 | 14.4 | 12.85 | 12.5 | 12.65 |
| 20 | 13.35 | 17.85 | 18.7 | 14.75 | 12.8 | 12.5 | 12.6 |
| 21 | 13.4 | 18.1 | 18.35 | 14.5 | 12.7 | 12.5 | 12.6 |
| 22 | 13.35 | 18.85 | 18.15 | 14.35 | 12.7 | 12.5 | 12.6 |

### *Daily gage height, in feet, of Grand River near Palisades, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 23 | 13.3 | 19.45 | 18.2 | 14.3 | 12.6 | 12.5 | 12.75 |
| 24 | 13.35 | 19.95 | 18.2 | 14.15 | 12.6 | 12.5 | 12.7 |
| 25 | 13.5 | 19.8 | 17.95 | 14.0 | 12.7 | 12.7 | 12.7 |
| 26 | 13.6 | 19.55 | 18.0 | 13.9 | 12.75 | 12.6 | 12.7 |
| 27 | 13.75 | 19.5 | 17.95 | 13.85 | 12.7 | 12.5 | 12.7 |
| 28 | 13.95 | 19.4 | 17.7 | 13.75 | 12.65 | 12.5 | 12.7 |
| 29 | 14.35 | 19.0 | 17.4 | 13.7 | 12.65 | 13.0 | 12.7 |
| 30 | 14.85 | 18.7 | 17.3 | 13.85 | 12.7 | 12.9 | 12.7 |
| 31 | ........ | 18.8 | ........ | 13.95 | 12.75 | ........ | 12.75 |

### *Station rating table for Grand River near Palisades, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 12.00 | 1,120 | 13.70 | 3,440 | 15.30 | 7,120 | 17.80 | 15,430 |
| 12.10 | 1,210 | 13.80 | 3,640 | 15.40 | 7,380 | 18.00 | 16,250 |
| 12.20 | 1,300 | 13.90 | 3,850 | 15.50 | 7,650 | 18.20 | 17,080 |
| 12.30 | 1,400 | 14.00 | 4,060 | 15.60 | 7,920 | 18.40 | 17,920 |
| 12.40 | 1,500 | 14.10 | 4,270 | 15.70 | 8,200 | 18.60 | 18,780 |
| 12.50 | 1,610 | 14.20 | 4,490 | 15.80 | 8,480 | 18.80 | 19,650 |
| 12.60 | 1,720 | 14.30 | 4,710 | 15.90 | 8,770 | 19.00 | 20,530 |
| 12.70 | 1,830 | 14.40 | 4,940 | 16.00 | 9,070 | 19.20 | 21,430 |
| 12.80 | 1,950 | 14.50 | 5,170 | 16.20 | 9,680 | 19.40 | 22,340 |
| 12.90 | 2,070 | 14.60 | 5,400 | 16.40 | 10,320 | 19.60 | 23,260 |
| 13.00 | 2,200 | 14.70 | 5,640 | 16.60 | 10,980 | 19.80 | 24,200 |
| 13.10 | 2,350 | 14.80 | 5,880 | 16.80 | 11,660 | 20.00 | 25,160 |
| 13.20 | 2,510 | 14.90 | 6,120 | 17.00 | 12,370 | 20.50 | 27,640 |
| 13.30 | 2,680 | 15.00 | 6,360 | 17.20 | 13,100 | 21.00 | 30,210 |
| 13.40 | 2,860 | 15.10 | 6,610 | 17.40 | 13,850 | 21.50 | 32,860 |
| 13.50 | 3,050 | 15.20 | 6,860 | 17.60 | 14,630 | 22.00 | 35,590 |
| 13.60 | 3,240 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905 and three high-water measurements of 1906. It is well defined.

### *Estimated monthly discharge of Grand River near Palisades, Colo., for 1905.*

[Drainage area, 8,546 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 6,000 | 1,500 | 2,644 | 157,300 | .309 | .345 |
| May | 24,920 | 6,120 | 13,080 | 804,300 | 1.53 | 1.76 |
| June | 35,870 | 13,470 | 24,440 | 1,454,000 | 2.86 | 3.19 |
| July | 12,370 | 3,440 | 6,084 | 374,100 | .712 | .821 |
| August | 4,600 | 1,720 | 2,527 | 155,400 | .296 | .341 |
| September | 2,275 | 1,610 | 1,830 | 108,900 | .214 | .239 |
| October | 1,890 | 1,610 | 1,747 | 107,400 | .204 | .235 |
| The period | ........ | ........ | ........ | 3,161,000 | ........ | ........ |

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in the Grand River basin in 1905.

*Miscellaneous discharge measurements made in Grand River drainage basin in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 9 | Willow Creek | Near Hot Sulphur Springs, Colo. | 42 | 115 | 5.77 | [a] 3.90 | 664 |
| June 28 | do | do | 28 | 30 | 1.67 | [a] 6.20 | 38 |
| July 27 | East Inlet | Grand Lake, Colo. | 33 | 47 | 1.64 | [b] 7.30 | 77 |
| August 17 | do | do | 21 | 25 | .92 | [b] 7.80 | 23 |
| September 11 | do | do | 24 | 13 | .77 | [c] 8.15 | 10 |
| March 28 | Yampa Hot Spring. | Glenwood Springs | 2.6 | 2.5 | 2.28 | 0.97 | 5.66 |
| July 10 | do | do | 2.6 | 2.6 | 2.31 | .99 | 6.00 |
| August 13 | do | do | 2.6 | 2.9 | 2.21 | 1.10 | 6.40 |

[a] Distance to water surface from bolt in stringer of southwest corner of bridge.
[b] Distance to water surface from knot indicated in overhanging tree.
[c] U. S. B. M.

## FRASER RIVER DRAINAGE BASIN.

### FRASER RIVER AT GRANBY, COLO.

Fraser River rises among the peaks of the Front Range in southeastern Grand County, Colo., and flows in a general northwesterly direction to its point of junction with Grand River in the east-central part of Middle Park. The stream receives a number of small tributaries, among which are Elk, St. Louis, Crooked, and Pole creeks, all short mountain streams draining the eastern slopes of the Vasquez Mountains.

The gaging station was established July 28, 1904. It is located on the main road between Coulter and Grand Lake, at the wagon bridge three-fourths mile southwest of Granby and about 4 miles above the mouth of the river, in sec. 9, T. 1 N., R. 76 W. In the 1904 Progress Report this station was called Fraser River, near Coulter, Colo.

The channel is straight for about 100 feet above and curved for 100 feet below the station. The right bank is about 2 feet high, is covered with willows, and overflows at high stages. The left bank above the station is a high, abrupt mesa; below the station it is a 6-foot mesa for about 50 feet, then a low, brush-covered flat, which is overflowed at high stages. The bed of the stream is composed of smooth cobblestones, and the cross section is fairly uniform, clean, and permanent. There is but one channel at all stages, broken by two crib piers, which cause boiling effects and back water at high stages. The current is swift at high and medium at low water. Gage heights have a range of about 2.5 feet during an ordinary season. Ice conditions render winter gage readings impracticable.

About 40 feet below the bridge a small temporary diversion dam is placed in the stream every year for the greater part of the low-water season to divert water into an irrigation ditch on the left bank. This weir backs the water up on the gage to a considerable depth and necessitates the construction of a separate rating curve for this period.

Discharge measurements are made from the downstream side of the three-span bridge to which the gage is attached. The initial point for soundings is immediately over the inner face of the left abutment and is marked with a circle on the downstream hand rail.

The gage, which was read twice each day during 1905 by J. N. Ostrander, a civil engineer, who lives but a few hundred feet away, is a staff, spiked vertically to the downstream inner edge of the first pier from the left bank. The gage reads from 2 feet to 10.8 feet, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows:

(1) A nail in the top of the white-pine stake driven into the left bank about 30 feet south of the left end of the bridge, projecting about 6 inches above the surface of the ground, and marked "U. S. G. S. B. M.;" elevation, 13.12 feet above the zero of the gage. (2) A cross cut on the top of the foundation stone at the southeast corner of the residence of the observer. The stone is marked "U. S. B. M." on the east face; elevation, 13.09 feet above the zero of the gage.

*Discharge measurements of Fraser River near Granby, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 3 | W. A. Lamb | 53 | 122 | 2.16 | 5.10 | 263 |
| May 30 | do | 58 | 168 | 4.03 | 5.70 | 677 |
| June 11 | do | 68 | 192 | 5.70 | 6.20 | 1,092 |
| June 30 | do | 54 | 145 | 3.41 | 5.50 | 495 |
| July 8 | do | 56 | 149 | 2.03 | 5.50 | 302 |
| July 26 | do | 52 | 118 | 1.40 | 5.01 | 165 |
| August 2 | do | 50 | 118 | 1.38 | 5.05 | 163 |
| August 16 | do | 44 | 94 | 1.06 | 4.75 | 100 |
| September 9 [a] | do | 42 | 61 | 1.26 | 4.60 | 77 |
| October 2 [a] | do | 39 | 60 | 1.17 | 4.60 | 70 |

[a] Made by wading above bridge.

*Daily gage height, in feet, of Fraser River at Granby, Colo., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 6.1 | 5.45 | 5.1 | 4.7 | 4.6 | 17 | 5.22 | 6.15 | 5.2 | 4.75 | 4.6 | 4.35 |
| 2 | | 6.12 | 5.4 | 5.05 | 4.62 | 4.6 | 18 | 5.32 | 6.05 | 5.2 | 4.7 | 4.55 | 4.35 |
| 3 | | 6.22 | 5.35 | 5.0 | 4.6 | 4.55 | 19 | 5.42 | 5.9 | 5.15 | 4.65 | 4.55 | 4.3 |
| 4 | | 6.55 | 5.3 | 4.95 | 4.6 | 4.5 | 20 | 5.48 | 5.85 | 5.25 | 4.65 | 4.5 | 4.25 |
| 5 | | 6.65 | 5.25 | 4.9 | 4.7 | 4.5 | 21 | 5.55 | 5.85 | 5.25 | 4.62 | 4.5 | 4.32 |
| 6 | | 6.4 | 5.25 | 4.9 | 4.7 | 4.5 | 22 | 5.69 | 5.85 | 5.15 | 4.6 | 4.5 | 4.25 |
| 7 | 4.88 | 6.5 | 5.15 | 4.9 | 4.7 | 4.5 | 23 | 5.88 | 5.85 | 5.1 | 4.6 | 4.5 | 4.3 |
| 8 | 5.08 | 6.5 | 5.3 | 4.85 | 4.72 | 4.5 | 24 | 5.78 | 5.8 | 5.12 | 4.62 | 4.5 | 4.3 |
| 9 | 5.15 | 6.6 | 5.5 | 4.82 | 4.6 | 4.5 | 25 | 5.65 | 5.72 | 5.08 | 4.62 | 4.5 | 4.4 |
| 10 | 4.98 | 6.42 | 5.4 | 4.8 | 4.6 | 4.42 | 26 | 5.68 | 5.75 | 5.05 | 4.65 | 4.45 | 4.4 |
| 11 | 4.92 | 6.35 | 5.35 | 4.92 | 4.6 | 4.4 | 27 | 5.78 | 5.7 | 5.0 | 4.65 | 4.45 | 4.4 |
| 12 | 4.9 | 6.3 | 5.3 | 5.05 | 4.6 | 4.35 | 28 | 5.9 | 5.58 | 4.98 | 4.65 | 4.4 | 4.4 |
| 13 | 5.02 | 6.35 | 5.28 | 4.95 | 4.6 | 4.35 | 29 | 5.72 | 5.55 | 5.0 | 4.7 | 4.5 | 4.4 |
| 14 | 4.92 | 6.3 | 5.3 | 4.88 | 4.6 | 4.35 | 30 | 5.72 | 5.5 | 5.1 | 4.7 | 4.5 | 4.4 |
| 15 | 4.9 | 6.35 | 5.3 | 4.82 | 4.6 | 4.3 | 31 | 5.78 | | 5.1 | 4.65 | | 4.4 |
| 16 | 5.05 | 6.35 | 5.3 | 4.75 | 4.6 | 4.3 | | | | | | | |

*Station rating table for Fraser River at Granby, Colo., from January 1 to July 8, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.90 | 180 | 5.40 | 431 | 5.90 | 819 | 6.40 | 1,313 |
| 5.00 | 218 | 5.50 | 499 | 6.00 | 910 | 6.50 | 1,422 |
| 5.10 | 262 | 5.60 | 572 | 6.10 | 1,005 | 6.60 | 1,533 |
| 5.20 | 313 | 5.70 | 649 | 6.20 | 1,104 | | |
| 5.30 | 369 | 5.80 | 732 | 6.30 | 1,207 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined.

*Station rating table for Fraser River at Granby, Colo., from July 9 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.20 | 26 | 4.60 | 74 | 5.00 | 154 | 5.40 | 267 |
| 4.30 | 35 | 4.70 | 91 | 5.10 | 179 | 5.50 | 302 |
| 4.40 | 46 | 4.80 | 110 | 5.20 | 206 | | |
| 4.50 | 59 | 4.90 | 131 | 5.30 | 235 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined between gage heights 4.6 feet and 5.5 feet. This second table is necessary on account of a dam which was put in a short distance below the gage.

*Estimated monthly discharge of Fraser River at Granby, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 7-31 | 819 | 172 | 451 | 22,360 |
| June | 1,590 | 499 | 1,030 | 61,290 |
| July | 465 | 149 | 250 | 15,370 |
| August | 179 | 74 | 110 | 6,764 |
| September | 95 | 46 | 70.1 | 4,171 |
| October | 74 | 30 | 47 | 2,890 |
| The period | | | | 112,800 |

## WILLIAMS FORK DRAINAGE BASIN.

### WILLIAMS FORK NEAR HOT SULPHUR SPRINGS, COLO.

Williams Fork rises in the Williams River Mountains in southeastern Grand County, flows in a general northwesterly direction, and unites with Grand River in the central part of Middle Park, Colorado.

The gaging station was established July 25, 1904. It is located at the wagon bridge on the ranch of F. A. Field, in T. 1 N., R. 79 W., about 9 miles west of Hot Sulphur Springs, 4 miles above the mouth of the stream, and below all the tributaries.

The channel is straight for about 100 feet above and below the station. The right bank is a low gravel bar, lined with willows, and at extreme high stages is overflowed for a distance of 75 feet from the second channel. The left bank is a level pasture land, about 4 feet high, and is not liable to overflow. The bed of the stream is composed of small and medium-sized bowlders and is permanent. At low water there is but one channel; at high water a second channel begins about 300 feet above the bridge, on the right side of the stream, passes about 100 feet from the right end of the bridge, and enters the main stream 200 feet below. This channel is very rough and irregular and is almost entirely covered with grass and shrubbery. The current is swift at high and medium at low stages. Gage heights have a range of about 1.8 feet in an ordinary season. During the winter months ice obstructs the channel to such an extent as to make gage readings impracticable. High-water measurements are affected by the back water and boiling caused by the middle pier of the bridge and by the roughness of bed of the second channel.

Discharge measurements are made from the downstream side of the 2-span wooden bridge to which the gage is attached. The initial point for soundings is a 60-penny nail driven into the top of the left end of the downstream guard rail of the bridge, immediately over the inside face of the abutment. The second channel formed at high water is measured by wading at convenient points.

The gage, which was read twice each day during 1905 by F. A. Field, is a staff, graduated from 2 to 8 feet, fastened vertically to the downstream end of the middle crib pier, the 2-foot mark resting on the bed of the stream. The bench mark is a 60-penny nail driven into the south face of a white-pine tree standing on the left bank of the river 30 feet north of the west end of the bridge; elevation, 6.03 feet above the zero of the gage. Elevation above sea level is about 7,600 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 146-148.

*Discharge measurements of Williams Fork near Hot Sulphur Springs, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 2 | W. A. Lamb | 50 | 85 | 2.73 | 3.89 | 232 |
| May 8 | do | 44 | 74 | 2.26 | 3.70 | 167 |
| May 29 | do | 54 | 103 | 3.65 | 4.15 | 376 |
| June 5 | do | 66 | 157 | 5.39 | 4.85 | 846 |
| June 8 | do | 64 | 147 | 5.60 | 4.80 | 824 |
| June 29 | do | 47 | 99 | 3.90 | 4.20 | 386 |
| July 12 | do | 48 | 91 | 2.36 | 3.85 | 215 |
| July 24 | do | 43 | 73 | 1.89 | 3.61 | 138 |
| August 29 | do | 33 | 54 | 1.13 | 3.31 | 61 |
| September 8 | do | 33 | 54 | 1.19 | 3.30 | 64 |
| September 29 | do | 25 | 44 | 1.11 | 3.23 | 49 |

*Daily gage height, in feet, of Williams Fork near Hot Sulphur Springs, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 3.19 | 3.84 | 4.39 | 4.18 | 3.58 | 3.33 | 3.32 |
| 2 | 3.14 | 3.88 | 4.48 | 4.11 | 3.52 | 3.29 | 3.32 |
| 3 | 3.12 | 3.80 | 4.55 | 4.09 | 3.51 | 3.32 | 3.30 |
| 4 | 3.13 | 3.70 | 4.72 | 4.02 | 3.52 | 3.30 | 3.26 |
| 5 | 3.18 | 3.62 | 4.82 | 3.98 | 3.50 | 3.31 | 3.22 |
| 6 | 3.20 | 3.57 | 4.72 | 3.94 | 3.51 | 3.34 | 3.22 |
| 7 | 3.24 | 3.63 | 4.82 | 3.90 | 3.50 | 3.34 | 3.22 |
| 8 | 3.25 | 3.71 | 4.78 | 3.90 | 3.50 | 3.30 | 3.22 |
| 9 | 3.32 | 3.74 | 4.89 | 3.89 | 3.48 | 3.29 | 3.22 |
| 10 | 3.36 | 3.65 | 4.80 | 3.84 | 3.49 | 3.28 | 3.10 |
| 11 | 3.34 | 3.62 | 4.68 | 3.84 | 3.50 | 3.28 | 3.18 |
| 12 | 3.36 | 3.60 | 4.68 | 3.82 | 3.52 | 3.26 | 3.19 |
| 13 | 3.40 | 3.71 | 4.74 | 3.80 | 3.50 | 3.26 | 3.24 |
| 14 | 3.34 | 3.63 | 4.68 | 3.81 | 3.48 | 3.25 | 3.18 |
| 15 | 3.28 | 3.60 | 4.70 | 3.80 | 3.46 | 3.22 | 3.18 |
| 16 | 3.30 | 3.69 | 4.68 | 3.76 | 3.40 | 3.21 | 3.28 |
| 17 | 3.30 | 3.84 | 4.65 | 3.71 | 3.40 | 3.26 | 3.24 |
| 18 | 3.38 | 3.92 | 4.55 | 3.70 | 3.38 | 3.29 | 3.21 |
| 19 | 3.44 | 3.98 | 4.52 | 3.76 | 3.39 | 3.36 | 3.16 |
| 20 | 3.38 | 4.05 | 4.45 | 3.76 | 3.35 | 3.30 | 3.14 |
| 21 | 3.32 | 4.05 | 4.46 | 3.72 | 3.34 | 3.30 | 3.14 |
| 22 | 3.39 | 4.15 | 4.42 | 3.71 | 3.36 | 3.28 | 3.22 |
| 23 | 3.39 | 4.22 | 4.40 | 3.64 | 3.38 | 3.28 | 3.27 |
| 24 | 3.42 | 4.22 | 4.43 | 3.62 | 3.36 | 3.24 | 3.30 |
| 25 | 3.42 | 4.18 | 4.34 | 3.61 | 3.31 | 3.24 | 3.24 |
| 26 | 3.45 | 4.18 | 4.36 | 3.61 | 3.30 | 3.26 | 3.24 |
| 27 | 3.56 | 4.25 | 4.28 | 3.62 | 3.28 | 3.26 | 3.24 |
| 28 | 3.62 | 4.24 | 4.25 | 3.60 | 3.28 | 3.22 | 3.30 |
| 29 | 3.66 | 4.12 | 4.21 | 3.58 | 3.37 | 3.22 | 3.22 |
| 30 | 3.78 | 4.18 | 4.17 | 3.58 | 3.35 | 3.38 | 3.27 |
| 31 | | 4.31 | | 3.58 | 3.36 | | 3.30 |

*Station rating table for Williams Fork near Hot Sulphur Springs, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 25 | 3.60 | 130 | 4.10 | 335 | 4.60 | 650 |
| 3.20 | 40 | 3.70 | 160 | 4.20 | 390 | 4.70 | 730 |
| 3.30 | 60 | 3.80 | 200 | 4.30 | 450 | 4.80 | 810 |
| 3.40 | 80 | 3.90 | 240 | 4.40 | 510 | 4.90 | 900 |
| 3.50 | 105 | 4.00 | 285 | 4.50 | 580 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905 and is well defined.

*Estimated monthly discharge of Williams Fork near Hot Sulphur Springs, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 192 | 28 | 74.1 | 4,409 |
| May | 456 | 122 | 253 | 15,560 |
| June | 891 | 374 | 628 | 37,370 |
| July | 379 | 125 | 201 | 12,360 |
| August | 125 | 56 | 87.6 | 5,386 |
| September | 76 | 42 | 56.5 | 3,362 |
| October | 64 | 25 | 46.6 | 2,865 |
| The period | | | | 81,310 |

## TROUBLESOME RIVER DRAINAGE BASIN.

### TROUBLESOME RIVER AT TROUBLESOME, COLO.

Troublesome River rises among the peaks of the Continental Divide in the northern part of Grand County, Colo., and flows southward to its point of junction with Grand River in Middle Park.

The gaging station was established July 22, 1904. It is located about 100 yards below the highway bridge at Troublesome, Colo., in sec. 12, T. 1 N., R. 80 W.

The channel is straight for about 50 feet above and 100 feet below the station. The right bank is about 3 feet high and is lined with a heavy growth of willows; the left bank is precipitous, is about 4 feet high, and is bordered by a level meadow; neither bank overflows. The bed of the stream is composed of small cobblestones and gravel, and is clean, uniform, and permanent. There is but one channel, broken by the piers of the bridge, which form eddies and undercurrents in a portion of the cross section. The current is very swift at high and medium at low stages. Gage heights have a range of about 2.5 feet in an ordinary season. During the winter months the channel is so obstructed by ice as to make gage readings impracticable.

Discharge measurements are ordinarily made by wading at convenient points near the gage rod. At extremely high stages they are made from the 2-span bridge about 100 yards above the gage-rod. The initial point for soundings is the west face of the stake driven into the top of the left bank, to which the gage rod is fastened.

The gage, which was read twice each day during 1905 by Mrs. Eva M. Becker, is an inclined staff, graduated from 0.8 foot to 5.8 feet, securely fastened to stakes driven into the left bank and bed of the stream. One vertical foot equals 1.525 feet on the slope. The gage is referred to bench marks as follows: (1) A 10-penny nail driven into the top of the stake on the left bank to which the gage is fastened; elevation, 5.83 feet above the zero of the gage.

(2) The center of a black cross painted on the bottom log near the southeast corner of Mrs. E. M. Becker's house, marked "U. S.+B. M.;" elevation, 16.08 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 148–150.

*Discharge measurements of Troublesome River at Troublesome, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 29 | W. A. Lamb | 30 | 39 | 2.28 | 2.57 | 89 |
| May 8 | do | 31 | 45 | 2.71 | 2.72 | 122 |
| May 28 | do | 42 | 95 | 4.73 | 3.40 | 449 |
| June 5 | do | 43 | 108 | 5.32 | 3.70 | 575 |
| June 8 | do | 40 | 93 | 5.14 | 3.35 | 478 |
| June 29 | do | 26 | 36 | 1.64 | 1.75 | 59 |
| July 11 | do | 16 | 9.3 | 0.86 | 1.12 | 8 |
| July 24 | do | 18 | 19 | 0.58 | 1.18 | 11 |
| August 13 | do | 23 | 25 | 0.88 | 1.38 | 22 |
| August 27 | do | 22 | 23 | 0.83 | 1.34 | 19 |
| September 7 | do | 24 | 25 | 0.92 | 1.40 | 23 |
| September 29 | do | 23 | 23 | 0.87 | 1.35 | 20 |

NOTE.—Measurements made at different sections.

*Daily gage height, in feet, of Troublesome River at Troublesome, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 2.8 | 3.3 | 1.6 | 1.48 | 1.35 | 1.32 |
| 2 | 2.0 | 2.95 | 3.4 | 1.65 | 1.38 | 1.3 | 1.3 |
| 3 | 1.95 | 2.82 | 3.45 | 1.68 | 1.35 | 1.3 | 1.3 |
| 4 | 1.9 | 2.7 | 3.75 | 1.6 | 1.35 | 1.3 | 1.3 |
| 5 | 1.95 | 2.6 | 3.7 | 1.52 | 1.3 | 1.35 | 1.25 |
| 6 | 2.1 | 2.52 | 3.18 | 1.42 | 1.35 | 1.38 | 1.22 |
| 7 | 2.1 | 2.5 | 3.32 | 1.3 | 1.3 | 1.4 | 1.2 |
| 8 | 2.1 | 2.55 | 3.28 | 1.18 | 1.3 | 1.38 | 1.2 |
| 9 | 2.1 | 2.82 | 3.22 | 1.15 | 1.3 | 1.35 | 1.2 |
| 10 | 2.1 | 2.75 | 3.12 | 1.12 | 1.3 | 1.35 | 1.28 |
| 11 | 2.15 | 2.72 | 2.88 | 1.1 | 1.32 | 1.35 | 1.25 |
| 12 | 2.1 | 2.6 | 2.75 | 1.08 | 1.38 | 1.35 | 1.38 |
| 13 | 2.1 | 2.62 | 2.78 | 1.05 | 1.38 | 1.3 | 1.4 |
| 14 | 2.1 | 2.6 | 2.75 | 1.02 | 1.35 | 1.3 | 1.4 |
| 15 | 2.05 | 2.62 | 2.58 | 1.08 | 1.35 | 1.3 | 1.4 |
| 16 | 2.1 | 2.8 | 2.55 | 1.05 | 1.35 | 1.29 | 1.42 |
| 17 | 2.1 | 3.15 | 2.42 | 1.05 | 1.32 | 1.28 | 1.45 |
| 18 | 2.1 | 3.28 | 2.32 | 0.95 | 1.32 | 1.3 | 1.42 |
| 19 | 2.15 | 3.52 | 2.25 | 1.0 | 1.3 | 1.35 | 1.38 |
| 20 | 2.15 | ........ | 2.22 | 1.15 | 1.3 | 1.35 | 1.35 |
| 21 | 2.1 | ........ | 2.15 | 1.32 | 1.32 | 1.35 | 1.3 |
| 22 | 2.15 | ........ | 2.18 | 1.25 | 1.35 | 1.35 | 1.35 |
| 23 | 2.2 | ........ | 2.08 | 1.2 | 1.35 | 1.32 | 1.4 |
| 24 | 2.2 | ........ | 1.98 | 1.28 | 1.35 | 1.3 | 1.4 |
| 25 | 2.3 | ........ | 1.95 | 1.3 | 1.35 | 1.3 | 1.4 |
| 26 | 2.25 | ........ | 1.9 | 1.42 | 1.35 | 1.35 | 1.4 |
| 27 | 2.3 | ........ | 1.8 | 1.4 | 1.35 | 1.35 | 1.4 |
| 28 | 2.42 | 3.35 | 1.72 | 1.35 | 1.35 | 1.35 | 1.4 |
| 29 | 2.5 | 3.25 | 1.7 | 1.4 | 1.35 | 1.35 | 1.4 |
| 30 | 2.55 | 3.2 | 1.68 | 1.4 | 1.35 | 1.3 | 1.42 |
| 31 | | 3.08 | ........ | 1.42 | 1.35 | ........ | 1.48 |

*Station rating table for Troublesome River at Troublesome, Colo., from January 1 to May 19, 1905.*

| Gage. height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.90 | 14 | 2.40 | 63 | 2.90 | 167 | 3.40 | 322 |
| 2.00 | 21 | 2.50 | 78 | 3.00 | 196 | 3.50 | 357 |
| 2.10 | 29 | 2.60 | 96 | 3.10 | 226 | 3.60 | 392 |
| 2.20 | 39 | 2.70 | 117 | 3.20 | 257 | | |
| 2.30 | 50 | 2.80 | 141 | 3.30 | 289 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is well defined between gage heights 1.9 feet and 2.7 feet.

*Station rating table for Troublesome River at Troublesome, Colo., from May 20 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 5 | 1.80 | 68 | 2.60 | 229 | 3.40 | 475 |
| 1.10 | 7 | 1.90 | 84 | 2.70 | 255 | 3.50 | 510 |
| 1.20 | 10 | 2.00 | 102 | 2.80 | 282 | 3.60 | 546 |
| 1.30 | 15 | 2.10 | 121 | 2.90 | 311 | 3.70 | 584 |
| 1.40 | 22 | 2.20 | 141 | 3.00 | 342 | 3.80 | 623 |
| 1.50 | 31 | 2.30 | 162 | 3.10 | 374 | | |
| 1.60 | 42 | 2.40 | 183 | 3.20 | 407 | | |
| 1.70 | 54 | 2.50 | 205 | 3.30 | 441 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 1.1 feet and 1.8 feet, and is fairly accurate to gage height 3.8 feet.

*Estimated monthly discharge of Troublesome River at Troublesome, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 87 | 14 | 35.1 | 2,089 |
| May, 23 days | 458 | 78 | 192 | 8,759 |
| June | 604 | 52 | 259 | 15,410 |
| July | 52 | 4.5 | 17.5 | 1,076 |
| August | 29 | 15 | 18.0 | 1,107 |
| September | 22 | 14 | 17.3 | 1,029 |
| October | 39 | 10 | 19.1 | 1,174 |
| The period | | | | 30,640 |

## MUDDY RIVER DRAINAGE BASIN.

### MUDDY RIVER AT KREMMLING, COLO.

Muddy River rises among the high peaks in the northwestern part of Grand County, Colo., and flows southeastward to the point where it unites with Grand River.

The gaging station was established July 24, 1904. It is located at the highway bridge about one-eighth mile northwest of Kremmling, in sec. 7, T. 1 N., R. 80 W., about 2 miles above the mouth of the river. The station is below all tributaries of importance.

The channel is curved for about 100 feet above and straight for 50 feet below the station. The right bank is about 8 feet high above and 10 feet high below the station, and is clean and almost perpendicular. The left bank below the bridge is 10 feet high, slopes at an angle of about 45 degrees, and is lined with willows; above the bridge it is irregular and about 8 feet high. The stream at this point does not overflow except at extremely high stages, and then only for a short distance back from the left bank. The bed of the stream is composed of mud, with some sand and a few loose rocks washed from the riprap near the south abutment of the bridge, and is clean but shifting. There is but one channel at all stages, broken by the middle pier of the bridge, which is irregularly shaped and causes back water and undercurrents in a portion of the cross section, affecting the discharge measurements at high stages. The current is medium at high and very sluggish at low water. The shifting of the bed makes it very difficult to obtain a good rating curve. Gage heights have a range of about 6 feet during an ordinary season. In the winter months ice obstructs the channel to such an extent that gage readings are impracticable.

At high-water stages discharge measurements are made from the downstream side of the two-span highway bridge to which the gage is attached. The initial point for soundings is a 10-penny nail driven into the downstream hand rail over the north face of the left abutment. The hand rail is marked from 0 to 58 feet with nails driven at 2-foot intervals. At ordinary and low-water stages measurements are made by wading at convenient points below the station.

The gage, which was read twice each day during 1905 by C. S. McGee, is a staff attached vertically to the lower left corner of the middle pier of the bridge. The gage reads from 2 to 14 feet, the 2-foot mark resting on the bed of the stream. The gage is referred to bench marks as follows: (1) A 60-penny spike driven horizontally into the west face of the left end of the downstream bridge stringer over the left abutment; elevation, 13.65 feet above the zero of the gage. (2) A 30-penny nail driven horizontally in the stringer at the east end of the north abutment of the bridge; elevation, 13.95 feet above the zero of the gage.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 150–151.

*Discharge measurements of Muddy River at Kremmling, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec. ft.* |
| April 28 | Wm. A. Lamb | 42 | 99 | 1.75 | 6.32 | 173 |
| May 8 | do | 41 | 140 | 1.81 | 6.90 | 254 |
| May 27 | do | 49 | 338 | 1.98 | 9.95 | 669 |
| June 7 | do | 48 | 354 | 1.90 | 10.10 | 671 |
| June 15 | do | 49 | 264 | 1.32 | 8.38 | 349 |
| June 26 | do | 52 | 66 | 1.18 | 6.35 | 78 |
| July 11 | do | 14 | 11 | 1.45 | 4.61 | 16 |
| July 24 | do | 11 | 6.6 | .95 | 4.30 | 6.3 |
| August 12 | do | 12 | 7.0 | 1.44 | 4.45 | 10 |
| August 25 | do | 9 | 4.0 | .72 | 4.10 | 2.9 |
| September 7 | do | 10 | 5.2 | 1.21 | 4.25 | 6.3 |
| September 29 | do | 10 | 5.6 | 1.02 | 4.25 | 5.7 |

**Note.**—Measurements made at different sections.

*Daily gage height, in feet, of Muddy River at Kremmling, Colo., for 1905.*

| Day | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 7.35 | 6.9 | 8.9 | 5.55 | 4.7 | 4.1 | 4.4 |
| 2 | 7.3 | 7.32 | 9.35 | 5.15 | 4.6 | 4.0 | 4.4 |
| 3 | 6.82 | 7.5 | 9.5 | 5.15 | 4.6 | 4.05 | 4.4 |
| 4 | 6.68 | 7.2 | 10.15 | 5.1 | 4.6 | 4.1 | 4.4 |
| 5: | 6.35 | 7.05 | 10.0 | 5.0 | 4.6 | 4.1 | 4.4 |
| 6 | 6.38 | 6.4 | 9.45 | 5.0 | 4.5 | 4.2 | 4.4 |
| 7 | 6.3 | 6.45 | 9.55 | 4.7 | 4.5 | 4.2 | 4.4 |
| 8 | 6.35 | 6.65 | 9.55 | 4.6 | 4.5 | 4.2 | 4.4 |
| 9 | 6.25 | 7.3 | 10.1 | 4.6 | 4.5 | 4.2 | 4.4 |
| 10 | 6.1 | 7.35 | 10.15 | 4.5 | 4.5 | 4.0 | 4.4 |
| 11 | 5.9 | 6.9 | 9.45 | 4.5 | 4.55 | 4.0 | 4.3 |
| 12 | 5.6 | 6.6 | 8.9 | 4.5 | 4.3 | 4.0 | 4.3 |
| 13 | 5.25 | 6.7 | 8.65 | 4.5 | 4.25 | 4.0 | 4.3 |
| 14 | 5.1 | 6.75 | 8.75 | 4.4 | 4.3 | 4.0 | 4.3 |
| 15 | 5.0 | 6.65 | 8.4 | 4.3 | 4.3 | 4.0 | 4.3 |
| 16 | 5.15 | 7.0 | 8.15 | 4.4 | 4.3 | 4.0 | 4.3 |
| 17 | 5.18 | 8.1 | 7.95 | 4.4 | 4.2 | 4.0 | 4.3 |
| 18 | 5.2 | 8.3 | 7.45 | 4.4 | 4.2 | 4.0 | 4.3 |
| 19 | 5.25 | 9.15 | 7.3 | 4.35 | 4.2 | 4.0 | 4.4 |
| 20 | 5.05 | 9.6 | 7.05 | 4.3 | 4.1 | 4.0 | 4.4 |
| 21 | 5.02 | 9.5 | 6.9 | 4.3 | 4.1 | 4.0 | 4.4 |
| 22 | 4.95 | 9.75 | 6.75 | 4.3 | 4.1 | 4.0 | 4.4 |
| 23 | 5.1 | 10.1 | 6.65 | 4.3 | 4.1 | 4.0 | 4.4 |
| 24 | 5.25 | 10.65 | 6.5 | 4.3 | 4.1 | 3.7 | 4.4 |
| 25 | 5.18 | 9.85 | 6.35 | 4.3 | 4.1 | 3.7 | 4.4 |
| 26 | 5.3 | 9.45 | 6.25 | 4.3 | 4.1 | 4.0 | 4.5 |
| 27 | 5.38 | 9.35 | 6.1 | 4.3 | 4.1 | 4.0 | 4.5 |
| 28 | 5.9 | 9.45 | 6.05 | 4.3 | 4.1 | 4.0 | 4.5 |
| 29 | 6.25 | 8.9 | 5.95 | 4.85 | 4.1 | 4.2 | 4.5 |
| 30 | 6.48 | 8.55 | 5.7 | 4.7 | 4.1 | 4.3 | 4.4 |
| 31 | ........ | 8.6 | ........ | 4.7 | 4.1 | ........ | 4.4 |

*Station rating table for Muddy River at Kremmling, Colo., from July 25, 1904, to June 4, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.20 | 5 | 5.50 | 85 | 6.70 | 223 | 7.90 | 380 |
| 4.30 | 8 | 5.60 | 95 | 6.80 | 236 | 8.00 | 394 |
| 4.40 | 11 | 5.70 | 105 | 6.90 | 249 | 8.20 | 422 |
| 4.50 | 15 | 5.80 | 116 | 7.00 | 262 | 8.40 | 450 |
| 4.60 | 19 | 5.90 | 127 | 7.10 | 275 | 8.60 | 478 |
| 4.70 | 24 | 6.00 | 138 | 7.20 | 288 | 8.80 | 506 |
| 4.80 | 29 | 6.10 | 150 | 7.30 | 301 | 9.00 | 534 |
| 4.90 | 35 | 6.20 | 162 | 7.40 | 314 | 9.20 | 562 |
| 5.00 | 42 | 6.30 | 174 | 7.50 | 327 | 9.40 | 590 |
| 5.10 | 50 | 6.40 | 186 | 7.60 | 340 | 9.60 | 618 |
| 5.20 | 58 | 6.50 | 198 | 7.70 | 353 | 9.80 | 646 |
| 5.30 | 67 | 6.60 | 210 | 7.80 | 366 | 10.00 | 674 |
| 5.40 | 76 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined. Above gage height 10 feet the rating curve is a tangent, the difference being 15 per tenth.

*Station rating table for Muddy River at Kremmling, Colo., from June 5 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.00 | 2 | 5.20 | 31 | 6.40 | 90 | 8.20 | 309 |
| 4.10 | 3 | 5.30 | 34 | 6.50 | 98 | 8.40 | 341 |
| 4.20 | 5 | 5.40 | 38 | 6.60 | 106 | 8.60 | 374 |
| 4.30 | 7 | 5.50 | 42 | 6.70 | 115 | 8.80 | 409 |
| 4.40 | 9 | 5.60 | 46 | 6.80 | 125 | 9.00 | 445 |
| 4.50 | 11 | 5.70 | 50 | 6.90 | 136 | 9.20 | 483 |
| 4.60 | 13 | 5.80 | 54 | 7.00 | 147 | 9.40 | 523 |
| 4.70 | 16 | 5.90 | 59 | 7.20 | 171 | 9.60 | 564 |
| 4.80 | 19 | 6.00 | 64 | 7.40 | 195 | 9.80 | 606 |
| 4.90 | 22 | 6.10 | 70 | 7.60 | 221 | 10.00 | 649 |
| 5.00 | 25 | 6.20 | 76 | 7.80 | 249 | 10.15 | 682 |
| 5.10 | 28 | 6.30 | 83 | 8.00 | 278 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905 and it is not well defined.

*Estimated monthly discharge of Muddy River at Kremmling, Colo., for 1904.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| July 25-31 | 8 | 5.6 | 6.9 | 96 |
| August | 29 | 5 | 11.4 | 701 |
| September | 36.4 | 5 | 14.8 | 881 |
| October | 19 | 8 | 13 | 799 |

*Estimated monthly discharge of Muddy River at Kremmling, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April | 308 | 38 | 121 | 7,200 |
| May | 772 | 186 | 408 | 25,090 |
| June | 696 | 50 | 337 | 20,050 |
| July | 44 | 7 | 14 | 861 |
| August | 16 | 3 | 7.1 | 436 |
| September | 7 | .5 | 2.7 | 161 |
| October | 11 | 7 | 8.7 | 535 |
| The period | | | | 54,330 |

## BLUE RIVER DRAINAGE BASIN.

### BLUE RIVER NEAR KREMMLING, COLO.

Blue River rises among the peaks of the Continental Divide in the extreme southeastern part of Summit County, Colo., and flows in a general northwesterly direction until it joins Grand River above the point where the latter stream enters Gore Canyon.

The gaging station was established July 21, 1904. It is located at the State highway bridge on the road between Kremmling and Dillon, Colo., 17 miles from the former and 26 miles from the latter, in T. 2 S., R. 80 W., and is below all tributaries of any importance.

The channel is straight for about 400 feet above and 200 feet below the station. The banks are lined with willows and are not liable to overflow. The bed of the stream is very rough, but is clean and stable. There is but one channel at all stages, broken by the center pier of the bridge. Several large bowlders in the channel near the gaging section cause a wave and boiling motion of the water at high stages and eddies and dead water during low stages. Gage heights have a range in an ordinary season of about 2.5 feet. During the winter months ice forms in the channel to such an extent as to make gage readings impracticable.

Discharge measurements are made from the downstream side of the two-span iron bridge to which the gage is attached. The initial point for soundings is a 4-penny nail driven into the downstream guard rail at the left end of the bridge immediately over the east face of the left abutment. It is marked zero.

The gage at this station is read once each day by Mrs. Dolly Heatherly, who lives 1 mile south of the bridge. The original gage was a staff, graduated from 2 to 11 feet, fastened vertically to the west face of the middle masonry pier near the downstream end. On August 26, 1904, this gage was removed and was replaced by a regulation chain gage, the elevation of the datum of the two gages being the same. In September, 1905, the wooden gage was reset in its original position and datum and is to be used during season of high water; at all other times the chain gage is to be used. The gage is referred to bench marks as follows: (1) A cross cut in the top of the second step from the top of the downstream wing of the left abutment, painted black, and marked "U. S.+B. M."; elevation, 9.04 feet above the zero of the gage. (2) A 60-penny spike driven vertically into the west end of the block, to which the pulley of the gage is fastened; elevation, 11.69 feet above the zero of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 151–153.

*Discharge measurements of Blue River near Kremmling, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec. ft.* |
| April 27[a] | W. A. Lamb | 108 | 151 | 2.29 | 2.50 | 346 |
| May 9 | do | 131 | 210 | 2.80 | 2.90 | 589 |
| May 26 | do | 147 | 371 | 5.01 | 3.50 | 1,860 |
| June 7 | do | 166 | 541 | 6.06 | 4.60 | 3,276 |
| June 28 | do | 151 | 382 | 4.53 | 3.45 | 1,732 |
| July 23 | do | 139 | 236 | 2.97 | 3.12 | 702 |
| August 12 | do | 125 | 212 | 2.70 | 2.82 | 572 |
| August 26 | do | 118 | 182 | 2.30 | 2.58 | 420 |
| September 6 | do | 115 | 182 | 2.43 | 2.59 | 422 |
| September 13 | do | 110 | 151 | 1.88 | 2.45 | 284 |
| September 28 | do | 99 | 125 | 1.69 | 2.30 | 211 |

[a] Channel partly filled with ice along sides and piers.

*Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.9 | 3.95 | 3.4 | 2.85 | 2.7 | 2.2 | 2.15 | 2.2 |
| 2 | | 3.0 | 4.0 | 3.4 | 2.8 | 2.5 | 2.3 | 2.15 | 2.0 |
| 3 | | 2.9 | 4.1 | 3.4 | 2.75 | 2.45 | 2.3 | 2.2 | 2.1 |
| 4 | | 2.95 | 4.2 | 3.2 | 2.7 | 2.5 | 2.25 | 2.3 | 2.0 |
| 5 | 2.1 | 2.8 | 4.3 | 3.1 | 2.7 | 2.5 | 2.2 | 2.25 | 1.7 |
| 6 | 2.1 | 2.6 | 4.0 | 3.1 | 2.7 | 2.5 | 2.25 | 2.25 | 1.7 |

*Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 2.2 | 2.65 | 4.1 | 3.0 | 2.7 | 2.5 | 2.25 | 2.25 | 2.0 |
| 8 | 2.2 | 2.8 | 4.15 | 3.0 | 2.7 | 2.5 | 2.25 | 2.2 | 2.2 |
| 9 | 2.25 | 2.9 | 4.45 | 3.0 | 2.6 | 2.45 | 2.2 | 2.15 | 2.3 |
| 10 | 2.3 | 3.0 | 4.0 | 2.9 | 2.6 | 2.3 | 2.2 | 2.1 | ........ |
| 11 | 2.3 | 2.8 | 4.0 | 2.9 | 2.6 | 2.3 | 2.15 | 2.2 | ........ |
| 12 | 2.3 | 2.75 | 3.95 | 2.9 | 2.6 | 2.3 | 2.1 | 2.2 | ........ |
| 13 | 2.3 | 2.95 | 4.05 | 2.9 | 2.7 | 2.3 | 2.2 | 2.2 | ........ |
| 14 | 2.35 | 2.8 | 3.95 | 2.8 | 2.6 | 2.3 | 2.2 | 2.2 | ........ |
| 15 | 2.2 | 2.7 | 4.0 | 2.95 | 2.6 | 2.3 | 2.2 | 2.2 | ........ |
| 16 | 2.3 | 2.7 | 3.95 | 2.9 | 2.6 | 2.25 | 2.2 | 2.15 | ........ |
| 17 | 2.3 | 2.9 | 4.0 | 2.9 | 2.5 | 2.2 | 2.25 | 2.1 | ........ |
| 18 | 2.35 | 3.05 | 3.75 | 2.8 | 2.5 | 2.25 | 2.25 | 2.15 | ........ |
| 19 | 2.5 | 3.6 | 3.65 | 2.85 | 2.45 | 2.3 | 2.2 | 2.1 | ........ |
| 20 | 2.4 | 3.65 | 3.65 | 2.8 | 2.45 | 2.3 | 2.2 | 2.15 | ........ |
| 21 | 2.35 | 3.65 | 3.55 | 2.8 | 2.45 | 2.3 | 2.3 | 2.3 | ........ |
| 22 | 2.4 | 3.55 | 3.5 | 2.85 | 2.4 | 2.3 | 2.25 | 2.2 | ........ |
| 23 | 2.35 | 3.75 | 3.7 | 2.8 | 2.4 | 2.3 | 2.25 | 2.1 | ........ |
| 24 | 2.4 | 3.65 | 3.75 | 2.8 | 2.4 | 2.25 | 2.25 | 2.1 | ........ |
| 25 | 2.4 | 3.6 | 3.55 | 2.85 | 2.45 | 2.3 | 2.25 | 2.2 | ........ |
| 26 | 2.4 | 3.5 | 3.65 | 2.9 | 2.5 | 2.3 | 2.3 | 2.1 | ........ |
| 27 | 2.5 | 3.6 | 3.55 | 2.85 | 2.45 | 2.3 | 2.3 | 2.2 | ........ |
| 28 | 2.6 | 3.55 | 3.55 | 2.8 | 2.45 | 2.25 | 2.3 | 2.15 | ........ |
| 29 | 2.65 | 3.6 | 3.45 | 2.8 | 2.5 | 2.2 | 2.25 | 2.0 | ........ |
| 30 | 2.8 | 3.65 | 3.4 | 2.8 | 2.5 | 2.2 | 2.2 | 2.0 | ........ |
| 31 | ........ | 3.7 | ........ | 2.8 | 2.65 | ........ | 2.2 | ........ | ........ |

## EAGLE RIVER DRAINAGE BASIN.

### EAGLE RIVER NEAR EAGLE, COLO.

Eagle River, an important headwater tributary of Grand River, rises among the high peaks of the Continental Divide, in Eagle County, Colo., immediately opposite the headwaters of Arkansas River, flows a little north of west for about 20 miles, and then in a general westerly direction to its junction with the Grand. It is a very rapid stream throughout its entire course, flowing alternately through canyons and narrow, terraced valleys.

The drainage area is almost wholly in Eagle County. The upper third of the basin is entirely mountainous, the general elevation at the crest of the divide being 12,000 feet above sea level, with peaks over 14,000 feet in altitude. In this part of its course the river descends in falls and cascades, the average slope above the mouth of Roche Moutonnée Creek being 150 feet per mile. The rocks are about equally divided between metamorphic granites and sedimentary formations. The forest cover is excellent, soil is shallow, and erosion is small. The annual precipitation, which is mostly in the form of snow, varies from 20 to 30 inches. This portion of the basin furnishes 90 per cent of the discharge of the stream.

The lower two-thirds of the basin is also mountainous but is less accentuated, the elevations varying from 7,000 to 11,000 feet. The rocks are largely sedimentary, erosion is greater, and the forest cover is meager. The precipitation is approximately 20 inches.

The principal tributaries of the Eagle are Gore, Roche Moutonnée, Gypsum, and Brush creeks.

Below Wolcott a few small ditches divert water for irrigation of the narrow first bench lands, and there is enough irrigation in Gypsum and Brush Creek valleys to divert the entire flow during the latter part of the season.

The gaging station was established March 12, 1905. It is located at Rule's private road bridge, in T. 5 S., R. 85 W., 2½ miles below Eagle, Colo. The chief object of the station is the collection of power data.

The channel is straight for 250 feet above and 150 feet below the station. The right bank is high, is composed of bowlders, cobblestones, and gravel, and does not overflow; the left bank, a long, narrow bottom bordered by abrupt mesa bluffs, overflows at high water to base of bluffs. Both banks are covered with scattered trees and brush. The bed of the stream is composed of cobblestones and bowlders and is permanent but very rough. There is but one channel at all stages. At low water there is an area of dead water at the left abutment, due to a depression in the bed of the stream under the bridge, and the current is sluggish; at high water this area of dead water disappears. The center of the current is very swift during high water. Above and below the bridge the velocity is much greater than at the bridge. The height of water ranges from 0.8 foot to 6 feet on the gage. Ice forms over the channel under the bridge during cold weather.

Discharge measurements are made from the downstream side of the 66-foot single-span wooden bridge, which stands at right angles to the stream current. The initial point for soundings is the face of the left abutment.

A vertical staff gage, which was read twice each day during 1905 by Kenneth Rule, is spiked to the face of the left abutment of the bridge. The gage is graduated from zero to 10 feet. The bench mark is a point encircled by paint and marked "B.M." on a large bowlder at the right of the bridge; elevation, 15.72 feet above the zero of the gage.

*Discharge measurements of Eagle River near Eagle, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 18 | R. I. Meeker | 40 | 119 | 1.57 | 0.80 | 187 |
| May 12 | do | 50 | 207 | 3.55 | 2.20 | 735 |
| July 10 | do | 45 | 233 | 3.41 | 2.40 | 794 |
| August 15[a] | do | 45 | 202 | 2.01 | 1.55 | 406 |
| September 25[a] | do | 60 | 162 | 1.22 | 1.00 | 198 |

[a] Made from Eagle bridge.

*Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.7 | 2.65 | 4.45 | 3.25 | 1.75 | 1.15 | 1.15 | 0.9 | 0.9 |
| 2 | | .8 | 3.0 | 4.7 | 3.05 | 1.7 | 1.05 | 1.15 | .9 | .95 |
| 3 | | .7 | 2.6 | 4.9 | 2.85 | 1.6 | .95 | 1.15 | 1.0 | .9 |
| 4 | | .65 | 2.35 | 5.8 | 2.65 | 1.65 | 1.25 | 1.05 | .95 | .8 |
| 5 | | .7 | 2.25 | 5.45 | 2.6 | 1.6 | 1.35 | 1.05 | .95 | .8 |
| 6 | | .7 | 2.0 | 5.35 | 2.6 | 1.6 | 1.35 | 1.05 | .95 | .8 |
| 7 | | .75 | 2.05 | 5.45 | 2.55 | 1.6 | 1.35 | 1.05 | .9 | .8 |
| 8 | | .9 | 2.25 | 5.45 | 2.6 | 1.6 | 1.45 | 1.05 | .9 | .9 |
| 9 | | 1.0 | 2.5 | 5.65 | 2.4 | 1.65 | 1.4 | 1.0 | .9 | 1.0 |
| 10 | | 1.15 | 2.45 | 5.65 | 2.4 | 1.6 | 1.35 | 1.0 | .9 | 1.2 |
| 11 | | 1.15 | 2.25 | 5.15 | 2.35 | 1.7 | 1.3 | 1.0 | .9 | 1.5 |
| 12 | | 1.25 | 2.15 | 4.8 | 2.3 | 1.75 | 1.35 | .95 | .9 | 2.0 |
| 13 | | 1.2 | 2.4 | 4.9 | 2.25 | 1.7 | 1.3 | .95 | .8 | 1.8 |
| 14 | | 1.25 | 2.25 | 4.95 | 2.2 | 1.65 | 1.25 | .9 | .8 | 2.0 |
| 15 | | 1.15 | 2.25 | 4.65 | 2.15 | 1.6 | 1.2 | .9 | .9 | 2.4 |
| 16 | | 1.2 | 2.5 | 4.4 | 2.05 | 1.55 | 1.05 | .95 | .9 | 2.4 |
| 17 | | 1.15 | 2.95 | 4.15 | 2.0 | 1.35 | 1.1 | .95 | .9 | 2.5 |

*Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1905*—Continued.

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | ........ | 1.2 | 3.25 | 4.2 | 1.85 | 1.3 | 1.1 | 0.95 | 0.9 | 2.4 |
| 19 | 0.8 | 1.4 | 3.55 | 3.9 | 1.85 | 1.15 | 1.1 | .9 | .9 | 2.4 |
| 20 | .8 | 1.35 | 3.75 | 3.85 | 1.8 | 1.15 | 1.0 | .95 | .9 | 2.4 |
| 21 | .7 | 1.25 | 3.85 | 3.95 | 1.75 | 1.1 | 1.0 | .95 | .9 | 2.4 |
| 22 | .75 | 1.3 | 4.2 | 3.7 | 1.7 | 1.0 | 1.05 | .9 | .9 | 2.5 |
| 23 | .7 | 1.3 | 4.5 | 3.8 | 1.7 | 1.0 | 1.0 | .9 | .9 | 2.5 |
| 24 | .65 | 1.4 | 4.5 | 3.85 | 1.7 | .95 | 1.0 | .9 | .9 | 2.6 |
| 25 | .7 | 1.4 | 4.1 | 3.75 | 1.7 | 1.0 | 1.0 | .9 | .9 | ........ |
| 26 | .7 | 1.35 | 4.15 | 3.8 | 1.7 | 1.0 | 1.0 | .9 | .9 | ........ |
| 27 | .78 | 1.5 | 4.25 | 3.7 | 1.65 | 1.05 | 1.0 | .95 | .9 | ........ |
| 28 | .7 | 1.75 | 4.2 | 3.7 | 1.75 | 1.05 | 1.0 | 1.0 | .9 | ........ |
| 29 | .65 | 2.2 | 3.9 | 3.45 | 1.8 | 1.15 | 1.15 | 1.0 | .9 | ........ |
| 30 | .7 | 2.35 | 3.9 | 3.4 | 1.7 | 1.25 | 1.2 | 1.1 | .9 | ........ |
| 31 | .7 | ........ | 4.4 | ........ | 1.7 | 1.3 | ........ | 1.1 | ........ | ........ |

## GUNNISON RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Gunnison River is formed in Gunnison County, Colo., by the union of East and Taylor rivers, two streams that have their origin among the snow-covered peaks and on the slopes of the Continental Divide in the northeastern part of the county and which descend through narrow mountain valleys and unite about 12 miles above Gunnison. From the junction of these rivers the Gunnison flows west and southwest to the point where it enters Grand River at Grand Junction, in the central part of Mesa County, Colo.

The upper course of the river lies through a broad, mountainous valley, but near the mouth of Lake Fork the valley narrows and the river enters the Black Canyon of the Gunnison, through which it winds in a tortuous course for 56 miles between granite walls that rise precipitously 3,000 feet above the water's edge. A short distance below the mouth of North Fork, the largest tributary of the river, the canyon walls break abruptly, and the valley is broad and fertile. Below Delta the river enters another narrow canyon, with walls averaging 800 feet in height, and this continues irregularly to Grand Junction, a few tracts of narrow bottom land lying between the channel and the canyon walls.

As an aid to description the basin may be divided into an upper, mountainous area and a lower, plateau area, the two being divided roughly by a north-south line drawn through the town of Hotchkiss.

The mountainous portion of the basin is the greater in area and varies in altitude from 6,000 to 14,000 feet. The geologic formations include large areas of igneous as well as sedimentary rocks, the soil cover is shallow, and large tracts are entirely barren. In the more inaccessible parts of the region the primeval forest still exists, but at many places, especially in the neighborhood of the mining camps, the timber has all been cut off. The prevailing forests are spruce, aspen, cedar, and characteristic mountain undergrowth. All the arable land in the high mountain valleys is devoted to forage crops, and a number of small ditches divert water for their irrigation. Power development of considerable magnitude is feasible in this part of the basin.

The plateau region embraces the Uncompahgre Plateau along the southwestern border of the basin, the Vernal and Inclinado mesas in the central part, and the Grand Mesa in the northern part. These plateaus have an extreme elevation of 10,000 feet above sea level and break down in a series of broad steps to the valleys, with parallel drainage lines cutting deeply at right angles through these steps. The topography is the product of erosion acting on sedimentary formations. The soil of the lower valleys is chiefly adobe, and the higher mesas have large content of gravel and sand. Groves of quaking aspen, interspersed with large, open grazing plots, cover broad areas of this plateau region. Forests of pine and aspen occur on the top of the Grand Mesa, with pinon pines and cedars along the foothills. In the valleys chico and sagebrush form the controlling vegetation, except along the streams, which are bordered to some extent by cottonwood, willow, and undergrowth.

The chief tributaries of the Gunnison are Ohio, Tomichi, Lake Fork, and Cimarron creeks and Smith, North Fork, and Uncompahgre rivers, the North Fork being the largest.

North Fork River rises in the Huntsman Hills, 20 miles south of Glenwood Springs, flows in a general south and southwesterly course, and unites with the Gunnison about 8 miles west of Hotchkiss. The drainage area is highly mountainous, except for a small portion which lies below Paonia, extreme points reaching an altitude of 13,000 feet. The mesa lands at the lower end of the valley stand 5,500 feet above sea level. The higher peaks are formed of granitic rocks, but lower down Cretaceous formations occupy at least 80 per cent of the area of the basin. The mountains are forested and the mesa lands are covered with sagebrush. All the tillable lands of the North Fork and its tributaries have been brought under cultivation, and irrigation is practiced to such an extent that the entire flow is needed for existing systems.

Uncompahgre River, the principal tributary of the Gunnison from the south, rises among the snowy peaks of the highly serrated Uncompahgre Mountains and flows a little west of north to its junction with the Gunnison at Delta. The basin embraces a mountainous, plateau, and valley area of 1,130 square miles, oblong in shape, the width increasing slightly at the lower end. The mountain area occupies but a small part of the basin, but contributes the perennial waters of the stream. The plateau area is greatest in extent and borders the valley on both sides, the larger Uncompahgre Plateau lying to the southwest. Escarpments are conspicuous features of this plateau. The relief features are terraced mesas flanked by shale buttes and ridges, trenched by deep, narrow canyons. Uncompahgre Valley proper begins at a point near Eldredge Siding, on the Denver and Rio Grande Railroad.

The other tributaries of the Gunnison need not here be described. Ohio, Tomichi, Lake Fork, and Cimarron creeks are perennial streams, but almost their entire volume is diverted for irrigation during the growing season, so that very little of their water reaches the Gunnison except at times of heavy storms or during spring floods.

Precipitation records for the Gunnison basin are meager. Those which exist show a range from 9 inches in the plateau region to about 25 inches in the mountains.

The natural flow of the Uncompahgre and North Fork rivers is diverted for irrigation along their respective valleys, and the Gunnison tunnel will divert water from the mountainous area and transmit it to the Uncompahgre Valley, which has been an irrigated district since the early eighties.

### EAST RIVER AT ALMONT, COLO.

East River rises in the Elk Mountains in the northern part of Gunnison County, Colo., flows in a general southerly direction, and unites with Taylor River to form the Gunnison.

The gaging station was established April 17, 1905. It is located at the county highway bridge at Almont, 100 feet above Taylor River, in T. 51 N., R. 85 W. The object of the station is the determination of the amount of flood waters available for storage in connection with the Uncompahgre Valley project and the collection of power data.

The channel section measures 75 feet between the bridge abutments and is straight for 100 feet both above and below the station. The banks are low and are liable to overflow at extreme high water. The bed of the stream is composed of bowlders and cobblestones and is very rough but generally permanent. There are two channels at all stages, divided by the center pier of the bridge, and the current is swift. Gage heights range from 0.7 foot to 5 feet.

Discharge measurements are made from the downstream side of the two-span wooden bridge. The initial point for soundings is the face of the left abutment and is indicated by a brass-headed tack in the hand rail, marked with a circle.

The gage, which was read during 1905 by Vernon Davis, is a vertical staff graduated from zero to 7 feet, spiked to the right end of the pier on the downstream side of the bridge. The bench mark is a point on a large stump in Cottage Grove on the right bank of the river, about 25 feet from the bridge, encircled by black paint and marked "B. M.;" elevation, 6.51 feet above the zero of the gage.

*Discharge measurements of East River at Almont, Colo., in 1904 and 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| 1904. | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 14 | R. I. Meeker | 73 | 182 | 6.62 | 2.60 | 1,205 |
| July 19 | do | 73 | 112 | 3.30 | 1.65 | 370 |
| August 16 | do | 73 | 105 | 3.01 | 1.55 | 316 |
| September 23 | do | 72 | 76 | 2.00 | 1.15 | 152 |
| 1905. | | | | | | |
| April 15 | do | 58 | 75 | 2.53 | 0.80 | 190 |
| May 26 | A. A. Weiland | 73 | 256 | 7.62 | 2.90 | 1,951 |
| June 17 | do | 73 | 237 | 7.89 | 3.10 | 1,869 |
| July 6 | do | 71 | 153 | 5.08 | 2.10 | 777 |
| August 10 | do | 64 | 94 | 2.86 | 1.50 | 269 |
| August 29 | do | 51 | 75 | 2.28 | 1.30 | 171 |

NOTE.—The 1904 measurements were made before the station was established. The gage heights were obtained from reference points.

*Daily gage height, in feet, of East River at Almont, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | | 1.75 | 3.25 | 2.35 | 1.9 | 1.3 | 1.0 |
| 2 | | 1.8 | 3.6 | 2.35 | 1.8 | 1.2 | .9 |
| 3 | | 1.7 | 4.35 | 2.3 | 1.7 | 1.2 | .9 |
| 4 | | 1.45 | 4.7 | 2.25 | 1.7 | 1.2 | .9 |
| 5 | | 1.4 | 4.55 | 2.15 | 1.7 | 1.2 | .9 |
| 6 | | 1.3 | 4.0 | 2.2 | 1.7 | 1.2 | .9 |
| 7 | | 1.3 | 3.85 | 2.0 | 1.7 | 1.3 | .9 |
| 8 | | 1.4 | 4.4 | 2.0 | 1.6 | 1.2 | .9 |
| 9 | | 1.55 | 4.75 | 1.95 | 1.5 | 1.2 | |
| 10 | | 1.45 | 4.15 | 1.85 | 1.5 | 1.2 | |
| 11 | | 1.45 | 3.85 | 1.85 | 1.5 | 1.2 | |
| 12 | | 1.4 | 3.55 | 1.85 | 1.5 | 1.2 | |
| 13 | | 1.5 | 3.65 | 1.85 | 1.5 | 1.2 | |
| 14 | | 1.5 | 3.55 | 1.85 | 1.4 | 1.2 | |
| 15 | | 1.45 | 3.55 | 1.85 | 1.4 | 1.2 | |
| 16 | 0.8 | 1.7 | 3.35 | 1.85 | 1.4 | 1.1 | |
| 17 | .75 | 1.9 | 2.95 | 1.85 | 1.4 | 1.1 | |
| 18 | .8 | 2.05 | 2.9 | 1.85 | 1.4 | 1.1 | |
| 19 | .9 | 2.45 | 2.7 | 1.8 | 1.4 | 1.1 | |
| 20 | .85 | 2.6 | 2.4 | 1.7 | 1.4 | 1.0 | |
| 21 | .8 | 2.75 | 2.55 | 1.8 | 1.4 | 1.0 | |
| 22 | .9 | 2.85 | 2.4 | 1.7 | 1.4 | 1.0 | |
| 23 | .85 | 3.3 | 2.5 | 1.7 | 1.4 | 1.0 | |
| 24 | .85 | 3.15 | 2.6 | 1.7 | 1.5 | 1.0 | |
| 25 | 1.05 | 2.85 | 2.5 | 1.75 | 1.5 | 1.0 | |
| 26 | 1.0 | 3.1 | 2.45 | 1.7 | 1.4 | 1.0 | |
| 27 | 1.1 | 3.0 | 2.4 | 1.75 | 1.4 | 1.0 | |
| 28 | 1.2 | 2.75 | 2.4 | 1.7 | 1.4 | 1.0 | |
| 29 | 1.45 | 2.55 | 2.4 | 1.7 | 1.4 | 1.0 | |
| 30 | 1.65 | 2.5 | 2.35 | 1.8 | 1.4 | 1.0 | |
| 31 | | 2.85 | | 2.1 | 1.4 | | |

*Station rating table for East River at Almont, Colo., from April 16 to June 1, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 190 | 1.50 | 420 | 2.20 | 850 | 2.90 | 1,610 |
| 0.90 | 210 | 1.60 | 470 | 2.30 | 940 | 3.00 | 1,750 |
| 1.00 | 240 | 1.70 | 520 | 2.40 | 1,030 | 3.10 | 1,900 |
| 1.10 | 270 | 1.80 | 580 | 2.50 | 1,130 | 3.20 | 2,060 |
| 1.20 | 300 | 1.90 | 640 | 2.60 | 1,240 | 3.30 | 2,220 |
| 1.30 | 340 | 2.00 | 700 | 2.70 | 1,360 | | |
| 1.40 | 380 | 2.10 | 770 | 2.80 | 1,480 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is not well defined. Estimates based on this table are rough approximations.

*Station rating table for East River at Almont, Colo., from June 2 to October 8, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 80 | 2.00 | 610 | 3.00 | 1,750 | 4.00 | 3,430 |
| 1.10 | 110 | 2.10 | 700 | 3.10 | 1,900 | 4.10 | 3,620 |
| 1.20 | 140 | 2.20 | 790 | 3.20 | 2,050 | 4.20 | 3,810 |
| 1.30 | 180 | 2.30 | 890 | 3.30 | 2,210 | 4.30 | 4,000 |
| 1.40 | 220 | 2.40 | 990 | 3.40 | 2,370 | 4.40 | 4,190 |
| 1.50 | 270 | 2.50 | 1,100 | 3.50 | 2,540 | 4.50 | 4,380 |
| 1.60 | 330 | 2.60 | 1,220 | 3.60 | 2,710 | 4.60 | 4,570 |
| 1.70 | 390 | 2.70 | 1,340 | 3.70 | 2,890 | 4.70 | 4,770 |
| 1.80 | 460 | 2.80 | 1,470 | 3.80 | 3,070 | 4.80 | 4,970 |
| 1.90 | 530 | 2.90 | 1,610 | 3.90 | 3,250 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905, and is well defined between gage heights 1.3 feet and 3.1 feet.

*Estimated monthly discharge of East River at Almont, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 16–30 | 495 | 180 | 249 | 7,408 |
| May | 2,220 | 340 | 910 | 55,950 |
| June | 4,870 | 940 | 2,329 | 138,600 |
| July | 940 | 390 | 537 | 33,020 |
| August | 530 | 220 | 280 | 17,220 |
| September | 180 | 80 | 117 | 6,962 |
| October 1–8 | 80 | 60 | 62.5 | 992 |
| The period | | | | 260,200 |

## TAYLOR RIVER NEAR ALMONT, COLO.

Taylor River rises in northeastern Gunnison County, Colo., among the high peaks of the Continental Divide, flows in a general southwesterly direction, and unites with East River to form the Gunnison.

The gaging station was established April 17, 1905. It is located at George Clark's private road bridge, 14 miles above Almont, Colo., in T. 15 S., R. 83 W. The object of the station is the determination of the amount of flood water available for storage in connection with the Uncompahgre Valley project, and the collection of power data.

The channel is straight for several hundred feet both above and below the station. The banks are both low, composed of bowlders and earth, are partly lined with willows, and are not liable to overflow. The stream bed is made up of large bowlders and cobblestones, and is very rough but permanent. The fall is large, the slope being equal to 0.016, or about 80 feet per mile. The crib piers of the bridge divide the channel into three parts. The velocity is rapid at all stages. Ice conditions interfere with measurements during the winter months. Accurate measurements are exceedingly hard to obtain on account of the roughness of the channel.

Discharge measurements are made from the downstream side of a pole bridge, which is 75 feet between abutments and is supported by two crib piers. The gage, which was read during 1905 by George Clark, is a vertical staff, graduated from zero to 7 feet, spiked to the left side of the left pier. The bench mark is a point, encircled with white paint and marked "B. M.," on top of a granite bowlder on the left bank just below the bridge; elevation above the zero of the gage, 4.34 feet.

*Discharge measurements of Taylor River near Almont, Colo., in 1904 and 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| 1904. | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 15 | R. I. Meeker | 58 | 142 | 5.61 | 2.22 | 796 |
| July 18 | do | 58 | 101 | 3.27 | 1.47 | 330 |
| August 17 | do | 58 | 104 | 3.88 | 1.77 | 404 |
| September 21 | do | 58 | 69 | 2.33 | 1.12 | 161 |
| 1905. | | | | | | |
| April 17 | R. I. Meeker | 44 | 64 | 1.78 | 1.00 | 114 |
| May 26 | A. A. Weiland | 58 | 173 | 5.76 | 2.60 | 996 |
| June 17 | do | 58 | 174 | 5.86 | 2.60 | 1,044 |
| July 6 | do | 58 | 130 | 3.32 | 1.70 | 432 |
| August 10 | do | 58 | 100 | 2.27 | 1.20 | 227 |
| August 29 | do | 58 | 99 | 2.03 | 1.10 | 201 |

NOTE.—The 1904 measurements were made before the station was established. The gage heights were obtained from reference points.

*Daily gage height, in feet, of Taylor River near Almont, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 2.1 | 3.4 | 1.9 | 1.45 | 1.1 | 1.1 | 1.0 |
| 2 | | 1.8 | 3.55 | 1.85 | 1.35 | 1.1 | 1.1 | 1.0 |
| 3 | | 1.35 | 3.75 | 1.75 | 1.4 | 1.1 | 1.1 | 1.0 |
| 4 | | 1.3 | 4.15 | 1.75 | 1.4 | 1.1 | 1.1 | 1.0 |
| 5 | | 1.25 | 4.25 | 1.7 | 1.35 | 1.1 | 1.1 | 1.0 |
| 6 | | 1.25 | 3.85 | 1.75 | 1.35 | 1.1 | 1.1 | 1.0 |
| 7 | | 1.15 | 3.8 | 1.65 | 1.3 | 1.1 | 1.1 | 1.0 |
| 8 | | 1.75 | 4.2 | 1.65 | 1.25 | 1.1 | 1.1 | 1.0 |
| 9 | | 1.55 | 4.4 | 1.6 | 1.2 | 1.1 | 1.1 | 1.0 |
| 10 | | 1.4 | 3.7 | 1.6 | 1.2 | 1.1 | 1.0 | 1.0 |
| 11 | | 1.4 | 3.4 | 1.55 | 1.25 | 1.1 | 1.0 | 1.0 |
| 12 | | 1.4 | 3.4 | 1.55 | 1.3 | 1.1 | 1.0 | 1.0 |
| 13 | | 1.45 | 3.6 | 1.55 | 1.25 | 1.1 | 1.0 | 1.0 |
| 14 | | 1.5 | 3.4 | 1.55 | 1.2 | 1.1 | 1.0 | 1.0 |
| 15 | | 1.6 | 3.4 | 1.55 | 1.2 | 1.1 | 1.0 | 1.0 |
| 16 | | 1.8 | 3.1 | 1.55 | 1.2 | 1.1 | 1.0 | 1.0 |

*Daily gage height, in feet, of Taylor River near Almont, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|
| 17 | 1.0 | 1.85 | 2.8 | 1.55 | 1.2 | 1.1 | 1.0 | 0.95 |
| 18 | 1.05 | 2.15 | 2.7 | 1.45 | 1.15 | 1.1 | 1.0 | .85 |
| 19 | 1.1 | 2.3 | 2.5 | 1.45 | 1.1 | 1.1 | 1.0 | .8 |
| 20 | 1.1 | 2.4 | 2.6 | 1.45 | 1.1 | 1.1 | 1.0 | .7 |
| 21 | 1.1 | 2.6 | 2.45 | 1.45 | 1.1 | 1.1 | 1.0 | .7 |
| 22 | 1.1 | 2.7 | 2.4 | 1.45 | 1.1 | 1.1 | 1.0 | .65 |
| 23 | 1.1 | 2.95 | 2.45 | 1.35 | 1.1 | 1.1 | 1.0 | .5 |
| 24 | 1.15 | 2.95 | 2.4 | 1.35 | 1.1 | 1.1 | 1.0 | .4 |
| 25 | 1.2 | 2.9 | 2.4 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 26 | 1.2 | 2.8 | 2.4 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 27 | 1.4 | 2.55 | 2.25 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 28 | 1.8 | 2.4 | 2.2 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 29 | 1.95 | 2.3 | 2.15 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 30 | 2.05 | 2.3 | 2.15 | 1.35 | 1.1 | 1.1 | 1.0 | ........ |
| 31 | ........ | 3.0 | ........ | 1.45 | 1.1 | ........ | 1.0 | ........ |

*Station rating table for Taylor River near Almont, Colo., from April 17 to May 26, 1905*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 115 | 1.60 | 365 | 2.20 | 725 | 2.80 | 1,190 |
| 1.10 | 150 | 1.70 | 420 | 2.30 | 795 | 2.90 | 1,280 |
| 1.20 | 185 | 1.80 | 475 | 2.40 | 870 | 3.00 | 1,370 |
| 1.30 | 225 | 1.90 | 535 | 2.50 | 945 | | |
| 1.40 | 270 | 2.00 | 595 | 2.60 | 1,025 | | |
| 1.50 | 315 | 2.10 | 660 | 2.70 | 1,105 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined.

*Station rating table for Taylor River near Almont, Colo., from May 27 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.40 | 70 | 1.30 | 255 | 2.20 | 725 | 3.20 | 1,555 |
| .50 | 85 | 1.40 | 290 | 2.30 | 795 | 3.40 | 1,750 |
| .60 | 100 | 1.50 | 330 | 2.40 | 870 | 3.60 | 1,950 |
| .70 | 115 | 1.60 | 375 | 2.50 | 945 | 3.80 | 2,160 |
| .80 | 135 | 1.70 | 425 | 2.60 | 1,025 | 4.00 | 2,370 |
| .90 | 155 | 1.80 | 480 | 2.70 | 1,105 | 4.20 | 2,580 |
| 1.00 | 175 | 1.90 | 535 | 2.80 | 1,190 | 4.40 | 2,790 |
| 1.10 | 200 | 2.00 | 595 | 2.90 | 1,280 | | |
| 1.20 | 225 | 2.10 | 660 | 3.00 | 1,370 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1 foot and 2.6 feet.

*Estimated monthly discharge of Taylor River near Almont, Colo., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| April 17 to 30 | 628 | 115 | 248 | 6,887 |
| May | 1,370 | 168 | 650 | 39,970 |
| June | 2,790 | 692 | 1,518 | 90,330 |
| July | 535 | 272 | 351 | 21,580 |
| August | 310 | 200 | 182 | 11,190 |
| September | 200 | 200 | 200 | 11,900 |
| October | 200 | 175 | 121 | 7,440 |
| November 1 to 24 | 175 | 70 | 156 | 7,426 |
| The period | | | | 196,700 |

## GUNNISON RIVER NEAR CIMARRON, COLO.

This station was established September 18, 1903. It is located at the Denver and Rio Grande Railroad bridge, 1½ miles from Cimarron, Colo., 1,000 feet above the mouth of Cimarron River, in T. 19 S., R. 91 W. The purpose of the station was the collection of hydrographic data relative to the Uncompahgre Valley project, which comtemplates the diversion of 1,300 cubic feet of water per second from Gunnison River about 12 miles below. The station was discontinued December 16, 1905, having been replaced by the station established at the east portal of Gunnison tunnel in April, 1905.

The channel is straight for 1,000 feet above and 300 feet below the station. The left bank is a granite cliff which rises vertically from the water. The right bank is a mountain slope of about 45°. The bed of the stream, which is permanent, is composed of granite bowlders along the sides with an even deposit of small cobblestones in the center. There is but one channel at all stages. At the cable section the left bank is an offset in the stream channel filled with a deposit of mud. The velocity is swift at low stages and very rapid during high water. Gage heights range from 3 to 12 feet.

Discharge measurements are made by means of a cable, car, stay, and tag lines. The initial point for soundings is at the face of the left cliff, 20 feet from the eye bolt to which cable is fastened, and is marked zero on the tag line.

A standard chain gage, which was read twice daily during 1905 by G. C. Gates, is installed on the upstream side of the Denver and Rio Grande Railroad bridge near the west end, about 75 feet downstream from the cable. The gage scale reads from zero to 10 feet, with two markers, giving a range of 20 feet in gage heights. The length of chain from end of weight to center of first marker is 56.06 feet. The bench mark is the top of the southeast corner capstone of the east masonry abutment of the Denver and Rio Grande Railroad bridge, a line being cut across the corner of the capstone to indicate the bench mark; elevation, 56.52 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 80–81; 133, p 157.
Discharge: 100, p 81; 133, p 157.
Discharge, monthly: 100, p 82; 133, p 159.
Gage heights: 100, p 81; 133, p 158.
Rating table: 100, p 82; 133, p 158.

*Discharge measurements of Gunnison River near Cimarron, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 1 | R. I. Meeker | 90 | 235 | 2.71 | 4.30 | 636 |
| May 23 | A. A. Weiland | 115 | 1,420 | 6.84 | 14.50 | 9,719 |
| June 6 | do | 110 | 1,612 | 7.37 | 16.50 | 11,880 |
| June 18 | do | 110 | 1,249 | 6.01 | 13.20 | 7,506 |
| July 1 | do | 100 | 768 | 4.86 | 9.40 | 3,736 |
| July 19 | do | 95 | 436 | 3.47 | 6.50 | 1,513 |
| August 11 | do | 85 | 362 | 3.35 | 5.90 | 1,214 |
| October 4 | R. I. Meeker | 78 | 239 | 2.44 | 4.40 | 583 |
| October 5 | do | 78 | 232 | 2.23 | 4.30 | 517 |

*Daily gage height, in feet, of Gunnison River near Cimarron, Colo., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.35 | 10.05 | 14.85 | 9.4 | 8.25 | 4.75 | 4.9 | 4.45 | 3.45 |
| 2 | | 4.45 | 10.15 | 15.6 | 8.95 | 7.35 | 4.7 | 4.55 | 4.05 | 3.25 |
| 3 | | 4.5 | 9.65 | 16.05 | 8.45 | 7.15 | 4.45 | 4.55 | 4.1 | 3.5 |
| 4 | | 4.45 | 8.25 | 17.15 | 7.55 | 7.0 | 4.55 | 4.4 | 4.15 | 3.95 |
| 5 | | 4.1 | 7.75 | 17.9 | 7.95 | 6.7 | 4.7 | 4.3 | 4.35 | 3.6 |
| 6 | | 4.25 | 7.55 | 16.6 | 7.8 | 6.45 | 4.75 | 4.25 | 4.25 | 3.75 |
| 7 | | 4.5 | 8.35 | 16.2 | 7.6 | 6.5 | 4.75 | 4.2 | 4.15 | 3.85 |
| 8 | | 4.8 | 8.5 | 16.9 | 7.5 | 6.35 | 4.7 | 4.1 | 4.1 | 3.85 |
| 9 | | 4.85 | 9.2 | 17.3 | 7.35 | 5.85 | 4.65 | 4.05 | 4.2 | 3.7 |
| 10 | 4.85 | 5.8 | 8.75 | 16.5 | 7.15 | 5.75 | 4.6 | 4.1 | 3.95 | 3.8 |
| 11 | 4.75 | 5.8 | 8.15 | 15.35 | 7.05 | 5.9 | 4.5 | 4.15 | 4.0 | 3.9 |
| 12 | 4.65 | 5.8 | 7.85 | 15.2 | 6.65 | 5.85 | 4.4 | 4.15 | 4.0 | 3.75 |
| 13 | 4.8 | 5.65 | 8.0 | 14.85 | 6.5 | 5.8 | 4.35 | 4.15 | 3.75 | 4.05 |
| 14 | 4.75 | 5.5 | 8.2 | 14.8 | 6.65 | 5.65 | 4.2 | 4.15 | 3.7 | 4.1 |
| 15 | 4.85 | 5.65 | 8.7 | 14.8 | 6.6 | 5.5 | 4.15 | 4.05 | 4.0 | 3.95 |
| 16 | 5.2 | 5.45 | 9.25 | 14.35 | 6.75 | 5.4 | 4.25 | 4.15 | 3.95 | 4.1 |
| 17 | 5.15 | 5.5 | 10.92 | 14.3 | 6.65 | 5.2 | 4.2 | 4.35 | 4.0 | 3.8 |
| 18 | 5.2 | 5.55 | 11.45 | 13.2 | 6.6 | 5.0 | 4.1 | 4.25 | 4.05 | |
| 19 | 5.0 | 5.9 | 12.5 | 12.55 | 6.5 | 4.95 | 4.1 | 4.05 | 4.0 | |
| 20 | 5.05 | 5.9 | 13.0 | 12.25 | 6.5 | 4.75 | 4.15 | 3.95 | 3.9 | |
| 21 | 4.7 | 5.65 | 13.25 | 12.2 | 6.55 | 4.55 | 4.2 | 4.1 | 4.1 | |
| 22 | 4.85 | 5.55 | 13.9 | 12.0 | 6.55 | 4.75 | 4.2 | 4.05 | 4.05 | |
| 23 | 4.45 | 5.75 | 14.6 | 11.45 | 6.35 | 4.8 | 4.1 | 4.3 | 4.15 | |
| 24 | 4.3 | 5.75 | 14.7 | 11.35 | 6.35 | 4.8 | 4.15 | 4.5 | 3.85 | |
| 25 | 4.3 | 5.9 | 14.2 | 11.3 | 6.2 | 5.05 | 4.2 | 4.25 | 3.7 | |
| 26 | 4.45 | 6.1 | 14.4 | 11.15 | 6.15 | 5.05 | 4.25 | 4.25 | 3.55 | |
| 27 | 4.5 | 6.55 | 14.8 | 11.1 | 6.05 | 5.0 | 4.3 | 4.25 | 4.35 | |
| 28 | 4.55 | 6.7 | 14.55 | 10.8 | 6.15 | 4.7 | 4.2 | 4.35 | 3.85 | |
| 29 | 4.25 | 8.3 | 12.5 | 10.6 | 6.65 | 4.9 | 4.15 | 4.2 | 3.4 | |
| 30 | 4.35 | 9.5 | 12.15 | 10.15 | 7.15 | 5.0 | 4.45 | 4.25 | 3.35 | |
| 31 | 4.3 | | 13.15 | | 7.9 | 5.0 | | 4.3 | | |

*Station rating table for Gunnison River near Cimarron, Colo., from March 10 to December 17, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 300 | 5.00 | 775 | 6.80 | 1,660 | 10.20 | 4,535 |
| 3.30 | 320 | 5.10 | 815 | 6.90 | 1,725 | 10.40 | 4,750 |
| 3.40 | 340 | 5.20 | 855 | 7.00 | 1,790 | 10.60 | 4,970 |
| 3.50 | 360 | 5.30 | 895 | 7.20 | 1,925 | 10.80 | 5,190 |
| 3.60 | 380 | 5.40 | 940 | 7.40 | 2,065 | 11.00 | 5,410 |
| 3.70 | 400 | 5.50 | 985 | 7.60 | 2,215 | 11.50 | 5,960 |
| 3.80 | 425 | 5.60 | 1,030 | 7.80 | 2,365 | 12.00 | 6,535 |
| 3.90 | 450 | 5.70 | 1,075 | 8.00 | 2,520 | 12.50 | 7,110 |
| 4.00 | 475 | 5.80 | 1,120 | 8.20 | 2,680 | 13.00 | 7,685 |
| 4.10 | 500 | 5.90 | 1,165 | 8.40 | 2,840 | 13.50 | 8,260 |
| 4.20 | 526 | 6.00 | 1,215 | 8.60 | 3,000 | 14.00 | 8,860 |
| 4.30 | 553 | 6.10 | 1,265 | 8.80 | 3,180 | 14.50 | 9,460 |
| 4.40 | 580 | 6.20 | 1,315 | 9.00 | 3,360 | 15.00 | 10,060 |
| 4.50 | 610 | 6.30 | 1,370 | 9.20 | 3,540 | 15.50 | 10,660 |
| 4.60 | 640 | 6.40 | 1,425 | 9.40 | 3,725 | 16.00 | 11,260 |
| 4.70 | 670 | 6.50 | 1,480 | 9.60 | 3,915 | 16.50 | 11,860 |
| 4.80 | 705 | 6.60 | 1,540 | 9.80 | 4,115 | | |
| 4.90 | 740 | 6.70 | 1,600 | 10.00 | 4,325 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is fairly well defined between gage heights 4 feet and 9.4 feet. The table has been extended beyond these limits. Above gage height 16.5 feet the rating curve is a tangent, the difference being 125 per tenth.

*Estimated monthly discharge of Gunnison River near Cimarron, Colo., for 1905.*

[Drainage area, 3,844 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 10-31 | 855 | 540 | 676 | 29,500 | 0.176 | 0.144 |
| April | 3,820 | 500 | 1,118 | 66,520 | .291 | .325 |
| May | 9,820 | 2,178 | 5,511 | 338,900 | 1.43 | 1.65 |
| June | 13,610 | 4,482 | 8,867 | 527,600 | 2.31 | 2.58 |
| July | 3,725 | 1,240 | 1,863 | 114,600 | .485 | .559 |
| August | 2,720 | 625 | 1,101 | 67,700 | .286 | .330 |
| September | 688 | 500 | 576 | 34,270 | .150 | .167 |
| October | 740 | 462 | 540 | 33,200 | .140 | .161 |
| November | 595 | 330 | 472 | 28,090 | .123 | .137 |
| December 1-17 | 500 | 310 | 424 | 14,300 | .110 | .070 |
| The period | | | | 1,255,000 | | |

## GUNNISON RIVER AT EAST PORTAL OF GUNNISON TUNNEL, COLORADO.

This station was established April 1, 1905, and replaces the Cimarron station, 12 miles above. It is located about 100 yards above the portal of the tunnel and is in T. 49 N., R. 7 W., 21 miles by wagon road from Montrose. The object of the station is to determine the volume of flow of the river at this point, as 1,300 second-feet will be diverted by the Gunnison tunnel when it is completed.

The channel is straight for 500 feet above and 300 feet below the station. The banks are steep, rocky mountain sides, and do not overflow. The bed of the stream is composed primarily of solid ledges of schists with a shifting deposit of gravel and sand which reaches a depth of 3 to 4 feet at low water. There is but one channel at all stages. The current is sluggish at low water, but becomes swift during high water. Gage heights range from 5 to 14 feet.

Discharge measurements are made by means of a cable, car, and tag line. The initial point for soundings is the left bank at high-water mark and is indicated by zero on tag line.

The gage, which is read twice daily by H. L. Daniels, is a vertical staff, graduated from zero to 15 feet, bolted to a vertical cliff on the right bank of the river 50 feet upstream from the cable. The bench mark is a United States Geological Survey standard aluminum tablet set in a rock ledge 50 feet south of the mouth of Gunnison tunnel; elevation of bench mark above the zero of the gage, 29.11 feet.

*Discharge measurements of Gunnison River at east portal of Gunnison tunnel, Colorado, in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 1 | O. McDermith | 1,301 | 3.48 | 9.05 | 4,529 |
| May 27 | do | 1,793 | 4.76 | 11.80 | 8,540 |
| June 3 | do | 2,105 | 5.32 | 12.80 | 11,200 |
| June 17 | do | 1,758 | 4.04 | 11.25 | 7,100 |
| June 20 | do | 1,649 | 4.06 | 10.60 | 6,690 |
| June 29 | do | 1,410 | 3.04 | 9.25 | 4,184 |
| July 6 | do | 1,166 | 2.17 | 7.60 | 2,525 |
| July 13 | do | 1,054 | 1.61 | 6.85 | 1,695 |
| August 3 | do | 1,091 | 1.87 | 7.12 | 2,044 |
| August 11 | do | 917 | 1.12 | 6.00 | 1,025 |
| August 19 | do | 860 | .89 | 5.60 | 763 |
| August 28 | do | 846 | .81 | 5.50 | 689 |
| September 13 | do | 806 | .71 | 5.24 | 575 |

*Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colorado, for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 8.95 | 11.95 | 8.75 | 7.85 | 5.5 | 5.55 | 5.3 | 5.2 |
| 2 | | 9.05 | 12.55 | 8.45 | 7.4 | 5.5 | 5.35 | 5.3 | 5.4 |
| 3 | | 8.65 | 12.85 | 8.15 | 7.15 | 5.4 | 5.3 | 5.3 | 5.6 |
| 4 | | 8.1 | 13.35 | 8.0 | 7.05 | 5.5 | 5.3 | 5.3 | 5.6 |
| 5 | | 7.8 | 13.95 | 7.85 | 6.85 | 5.5 | 5.25 | 5.3 | 5.6 |
| 6 | | 7.6 | 13.15 | 7.65 | 6.75 | 5.6 | 5.2 | 5.3 | 5.6 |
| 7 | | 7.6 | 12.9 | 7.6 | 6.65 | 5.6 | 5.2 | 5.25 | 5.7 |
| 8 | | 7.9 | 13.1 | 7.6 | 6.4 | 5.5 | 5.2 | 5.2 | 6.0 |
| 9 | 5.9 | 8.4 | 13.65 | 7.45 | 6.2 | 5.5 | 5.2 | 5.2 | 6.0 |
| 10 | 6.05 | 8.75 | 13.05 | 7.25 | 6.2 | 5.45 | 5.15 | 5.2 | 6.0 |
| 11 | 6.2 | 7.95 | 12.55 | 7.05 | 6.15 | 5.35 | 5.1 | 5.2 | 6.0 |
| 12 | 6.25 | 7.8 | 12.25 | 7.0 | 6.05 | 5.3 | 5.1 | 5.1 | 6.0 |
| 13 | 6.1 | 8.0 | 12.1 | 6.85 | 6.0 | 5.25 | 5.1 | 5.1 | 6.0 |
| 14 | 6.15 | 7.9 | 11.9 | 6.8 | 6.0 | 5.2 | 5.1 | 5.0 | 6.0 |
| 15 | 6.0 | 8.05 | 11.9 | 6.8 | 6.0 | 5.2 | 5.1 | 5.1 | 6.0 |
| 16 | e6.1 | 8.48 | 11.75 | 6.8 | 5.85 | 5.2 | 5.1 | 5.05 | 6.0 |
| 17 | 6.18 | 9.5 | 11.2 | 6.8 | 5.8 | 5.15 | 5.2 | 5.1 | 6.1 |

*Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colorado, in 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 18 | 6.28 | 9.9 | 10.95 | 6.8 | 5.7 | 5.1 | 5.2 | 5.2 | 6.5 |
| 19 | 6.42 | 10.5 | 10.65 | 6.7 | 5.6 | 5.1 | 5.2 | 5.15 | 6.5 |
| 20 | 6.38 | 10.85 | 10.6 | 6.6 | 5.6 | 5.2 | 5.2 | 5.0 | 6.5 |
| 21 | 6.2 | 11.15 | 10.5 | 6.6 | 5.5 | 5.2 | 5.2 | 5.1 | 6.6 |
| 22 | 6.15 | 11.45 | 10.15 | 6.6 | 5.5 | 5.1 | 5.2 | 5.15 | 6.6 |
| 23 | 6.2 | 11.95 | 9.95 | 6.6 | 5.5 | 5.1 | 5.2 | 5.2 | 6.5 |
| 24 | 6.3 | 11.9 | 9.85 | 6.6 | 5.5 | 5.1 | 5.25 | 5.1 | 6.3 |
| 25 | 6.4 | 11.7 | 9.8 | 6.5 | 5.65 | 5.1 | 5.2 | 5.1 | 6.3 |
| 26 | 6.55 | 11.75 | 9.75 | 6.5 | 5.65 | 5.2 | 5.3 | 5.1 | 6.3 |
| 27 | 6.82 | 11.75 | 9.65 | 6.65 | 5.5 | 5.1 | 5.3 | 5.2 | 6.3 |
| 28 | 7.28 | 11.5 | 9.6 | 6.5 | 5.5 | 5.2 | 5.3 | 5.2 | 6.3 |
| 29 | 7.8 | 10.75 | 9.35 | 6.5 | 5.7 | 5.2 | 5.3 | 5.2 | 6.3 |
| 30 | 8.35 | 10.8 | 9.05 | 6.9 | 5.65 | 5.4 | 5.3 | 5.2 | 6.3 |
| 31 | ........ | 10.9 | ........ | 7.8 | 5.6 | ........ | 5.3 | ........ | 6.3 |

## GUNNISON RIVER NEAR CORY, COLO.

This station was established April 30, 1903. It is located at the wooden highway bridge on the road between Delta and Cory, Colo., about 6 miles east of Delta.

The channel is over 200 feet wide and is straight for 300 feet above and 500 feet below the station. The right bank is abrupt, high, and wooded, and does not overflow; the left bank is a gradual slope of cobblestones, gravel, and sand to the annual flood plain; is partly covered with trees and underbrush, and overflows at extreme high water. The bed of the stream is composed of bowlders and cobblestones and is permanent. There is but one channel at all stages. The current is swift at high water. Gage heights range from 5 to 13 feet.

Discharge measurements are made from the downstream side of the two-span bridge. The initial point for soundings is a brass tack in the hand rail at the center of the left pier, downstream side of bridge.

A standard chain gage, which was read twice daily during 1905 by John Shea, is located on the downstream side of the bridge 90 feet from the right bank. The gage scale reads from zero to 10 feet, with two markers, allowing for a range of 20 feet in gage heights, the second marker being used above 10 feet. The length of the chain from the end of the weight to the center of the second marker is 14.12 feet. The bench mark is the top edge of the iron rim of the northwest cylinder pier, downstream side of bridge, marked with white paint at the point of B. M.; elevation above the datum of the gage, 17.59 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 76; 133, p 159.
Discharge: 100, pp 76, 93; 133, p 160.
Discharge, monthly: 100, p 78; 133, p 161.
Gage heights: 100, p 77; 133, p 160.
Rating table: 100, p 77; 133, p 161.

*Discharge measurements of Gunnison River near Cory, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 10 | R. I. Meeker | 188 | 760 | 2.70 | 6.85 | 2,052 |
| May 6 | Oro McDermith | 213 | 1,090 | 4.03 | 8.20 | 4,388 |
| May 19 | A. A. Weiland | 256 | 1,682 | 7.88 | 10.95 | 13,280 |
| May 21 | R. I. Meeker | 260 | 1,785 | 8.11 | 11.35 | 14,480 |
| May 21 | A. A. Weiland | 260 | 1,785 | 8.04 | 11.25 | 14,350 |
| May 31 | do | 256 | 1,688 | 7.64 | 10.95 | 12,890 |
| June 3 | do | 269 | 2,056 | 8.86 | 12.20 | 18,220 |
| June 13 | do | 266 | 1,893 | 8.38 | 11.80 | 15,860 |
| June 27 | do | 232 | 1,329 | 5.57 | 9.45 | 7,405 |
| July 11 | do | 200 | 852 | 3.09 | 7.30 | 2,632 |
| August 1 | do | 210 | 942 | 3.46 | 7.70 | 3,263 |
| October 2 | R. I. Meeker | 180 | 566 | 1.54 | 5.90 | 870 |

*Daily gage height, in feet, of Gunnison River near Cory, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.25 | 5.5 | 5.6 | 6.0 | 9.8 | 11.75 | 8.75 | 7.6 | 5.8 | 5.8 | 5.7 | 5.35 |
| 2 | 5.3 | 5.5 | 5.8 | 6.0 | 10.2 | 12.15 | 8.55 | 7.35 | 5.85 | 5.8 | 5.75 | 5.3 |
| 3 | 5.3 | 5.5 | 5.8 | 6.0 | 9.5 | 12.2 | 8.4 | 7.05 | 5.85 | 5.8 | 5.7 | 5.3 |
| 4 | 5.4 | 5.5 | 5.85 | 6.0 | 8.9 | 12.7 | 8.25 | 7.0 | 5.95 | 5.7 | 5.7 | 5.3 |
| 5 | 5.45 | 5.5 | 5.85 | 5.9 | 8.5 | 13.1 | 7.95 | 6.9 | 5.8 | 5.7 | 5.7 | 5.4 |
| 6 | 5.45 | 5.4 | 5.9 | 5.9 | 8.25 | 12.7 | 7.9 | 6.75 | 5.8 | 5.7 | 5.6 | 5.4 |
| 7 | 5.45 | 5.5 | 6.0 | 5.9 | 8.4 | 12.35 | 7.8 | 6.55 | 5.8 | 5.7 | 5.6 | 5.4 |
| 8 | 5.4 | 5.4 | 6.0 | 6.2 | 8.55 | 12.8 | 7.65 | 6.5 | 5.85 | 5.7 | 5.6 | 5.45 |
| 9 | 5.3 | 5.5 | 5.9 | 6.65 | 9.3 | 12.85 | 7.55 | 6.45 | 5.8 | 5.7 | 5.6 | 5.4 |
| 10 | 5.3 | 5.5 | 6.0 | 6.85 | 9.0 | 12.63 | 7.45 | 6.45 | 5.8 | 5.7 | 5.6 | 5.3 |
| 11 | 5.3 | 5.45 | 6.0 | 6.85 | 8.65 | 12.13 | 7.3 | 6.4 | 5.75 | 5.6 | 5.6 | 5.3 |
| 12 | 5.25 | 5.4 | 6.0 | 6.95 | 8.55 | 11.93 | 7.25 | 6.4 | 5.7 | 5.6 | 5.6 | 5.35 |
| 13 | 5.25 | 5.4 | 6.0 | 6.95 | 8.7 | 11.88 | 7.2 | 6.4 | 5.75 | 5.6 | 5.55 | 5.35 |
| 14 | 5.25 | 5.5 | 6.0 | 6.95 | 8.7 | 11.53 | 7.05 | 6.4 | 5.7 | 5.6 | 5.55 | 5.4 |
| 15 | 5.25 | 5.45 | 6.05 | 6.85 | 8.75 | 11.43 | 7.0 | 6.3 | 5.7 | 5.65 | 5.5 | 5.4 |
| 16 | 5.3 | 5.4 | 6.1 | 6.95 | 9.2 | 11.28 | 7.0 | 6.2 | 5.7 | 5.75 | 5.6 | 5.4 |
| 17 | 5.3 | 5.5 | 6.1 | 7.0 | 10.2 | 10.88 | 6.9 | 6.0 | 5.7 | 5.7 | 5.6 | 5.4 |
| 18 | 5.4 | 5.5 | 6.2 | 7.05 | 10.55 | 10.58 | 6.8 | 6.0 | 5.8 | 5.75 | 5.6 | 5.4 |
| 19 | 5.4 | 5.5 | 6.3 | 7.2 | 11.1 | 10.48 | 6.8 | 6.0 | 5.7 | 5.8 | 5.6 | 5.4 |
| 20 | 5.4 | 5.45 | 6.3 | 7.15 | 11.35 | 10.28 | 6.75 | 5.9 | 5.75 | 5.8 | 5.5 | 5.4 |
| 21 | 5.4 | 5.4 | 6.3 | 7.05 | 11.5 | 10.06 | 6.75 | 5.8 | 5.75 | 5.8 | 5.5 | 5.45 |
| 22 | 5.4 | 5.4 | 6.2 | 7.05 | 11.8 | 9.96 | 6.7 | 5.8 | 5.7 | 5.8 | 5.5 | ....... |
| 23 | 5.3 | 5.4 | 6.2 | 6.95 | 12.2 | 9.81 | 6.7 | 5.8 | 5.7 | 5.8 | 5.5 | ....... |
| 24 | 5.35 | 5.4 | 6.1 | 7.25 | 12.3 | 9.76 | 6.75 | 5.75 | 5.7 | 5.7 | 5.5 | ....... |
| 25 | 5.35 | 5.4 | 6.0 | 7.45 | 11.9 | 9.56 | 6.7 | 5.7 | 5.7 | 5.7 | 5.5 | ....... |
| 26 | 5.3 | 5.4 | 6.0 | 7.5 | 11.9 | 9.51 | 6.75 | 5.7 | 5.7 | 5.7 | 5.5 | ....... |
| 27 | 5.3 | 5.5 | 6.0 | 7.75 | 11.95 | 9.41 | 6.8 | 5.7 | 5.7 | 5.7 | 5.55 | ....... |
| 28 | 5.35 | 5.5 | 6.0 | 8.3 | 11.65 | 9.4 | 6.85 | 5.8 | 5.7 | 5.7 | 5.6 | ....... |
| 29 | 5.3 | ....... | 6.0 | 8.85 | 10.85 | 9.15 | 6.9 | 5.8 | 5.7 | 5.7 | 5.5 | ....... |
| 30 | 5.4 | ....... | 6.0 | 9.25 | 10.5 | 8.9 | 7.05 | 5.85 | 5.75 | 5.7 | 5.45 | ....... |
| 31 | 5.5 | ....... | 6.0 | ....... | 10.95 | ....... | 7.4 | 5.8 | ....... | 5.75 | ....... | 6.50 |

*Station rating table for Gunnison River near Cory, Colo., from January 1 to December 21, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.20 | 430 | 6.60 | 1,630 | 8.00 | 3,810 | 9.80 | 8,490 |
| 5.30 | 480 | 6.70 | 1,750 | 8.10 | 4,010 | 10.00 | 9,180 |
| 5.40 | 530 | 6.80 | 1,870 | 8.20 | 4,210 | 10.20 | 9,910 |
| 5.50 | 590 | 6.90 | 2,000 | 8.30 | 4,410 | 10.40 | 10,660 |
| 5.60 | 660 | 7.00 | 2,130 | 8.40 | 4,620 | 10.60 | 11,450 |
| 5.70 | 730 | 7.10 | 2,270 | 8.50 | 4,840 | 10.80 | 12,280 |
| 5.80 | 810 | 7.20 | 2,420 | 8.60 | 5,070 | 11.00 | 13,130 |
| 5.90 | 900 | 7.30 | 2,570 | 8.70 | 5,300 | 11.20 | 14,000 |
| 6.00 | 990 | 7.40 | 2,730 | 8.80 | 5,540 | 11.40 | 14,880 |
| 6.10 | 1,090 | 7.50 | 2,900 | 8.90 | 5,790 | 11.60 | 15,790 |
| 6.20 | 1,190 | 7.60 | 3,070 | 9.00 | 6,050 | 11.80 | 16,730 |
| 6.30 | 1,290 | 7.70 | 3,250 | 9.20 | 6,600 | 12.00 | 17,700 |
| 6.40 | 1,400 | 7.80 | 3,430 | 9.40 | 7,190 | | |
| 6.50 | 1,510 | 7.90 | 3,620 | 9.60 | 7,820 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905. It is fairly well defined above gage height 5.9 feet. Above gage height 12 feet the rating curve is a tangent, the difference being 500 per tenth.

*Estimated monthly discharge of Gunnison River near Cory, Colo., for 1905.*

[Drainage area, 5,233 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 590 | 455 | 503 | 30,930 | 0.096 | 0.111 |
| February | 590 | 530 | 563 | 31,270 | 0.108 | 0.112 |
| March | 1,290 | 660 | 1,013 | 62,290 | 0.194 | 0.224 |
| April | 6,745 | 900 | 2,251 | 133,900 | 0.430 | 0.480 |
| May | 19,200 | 4,310 | 10,320 | 634,600 | 1.97 | 2.27 |
| June | 23,200 | 5,790 | 14,110 | 839,600 | 2.70 | 3.01 |
| July | 5,420 | 1,750 | 2,643 | 162,500 | 0.505 | 0.582 |
| August | 3,070 | 730 | 1,306 | 80,300 | 0.250 | 0.288 |
| September | 945 | 730 | 775 | 46,120 | 0.148 | 0.165 |
| October | 810 | 660 | 744 | 45,750 | 0.142 | 0.164 |
| November | 770 | 560 | 645 | 38,380 | 0.123 | 0.137 |
| December 1-21 | 560 | 480 | 517 | 21,530 | 0.099 | 0.077 |
| The period | | | | 2,127,000 | | |

## GUNNISON RIVER AT WHITEWATER, COLO.

This station was regularly established April 10, 1902, incomplete series of gage heights having been obtained during 1895, 1897, and 1901. It is located at the steel wagon bridge constructed by the State of Colorado at a point about one-half mile above the railroad station at Whitewater, on the Denver and Rio Grande Railroad. It was intended that this station should replace that formerly maintained on the Gunnison at Grand Junction, which was abandoned on account of conditions that rendered accurate gagings impossible.

The channel is straight for 1,000 feet above and 500 feet below the station. The cross section at the bridge is 282 feet wide, is uniform in area, and is clean. The right bank is of alluvial material, with abrupt slopes about 14 feet high; the left bank is of the same material, but slopes more gently and overflows at extreme high water. The bed of the stream is composed of cobblestones, coarse gravel, and sand, and is fairly permanent. At the center of the cross section the current is broken by cylindrical piers and old sheet piling, and a small area adjacent to these fills in with silt at low water but scours out during high water. There is but one channel at all stages. The current is moderate at low water but swift at high. Gage heights range from 3.5 to 14 feet.

Discharge measurements are made from the downstream side of the two-span steel bridge. A stay line is used at high water. The initial point for soundings is the edge of the capstone of the left masonry abutment on the downstream side of the bridge.

The gage, which was read twice daily during 1905 by James Page, was originally of wire, and was located on the downstream side of the right span. On April 8, 1904, the old gage was replaced by a new chain gage with the same datum. The gage scale is graduated from zero to 10 feet, with two markers, giving a range of 20 feet in gage heights. The length of the chain from the end of the weight to the center of the first marker is 21.59 feet. The second marker is 11.59 feet from end of weight and is used when gage heights are above 10 feet. The bench mark, established July 3, 1904, is a standard United States Geological Survey iron bench-mark post located about 40 feet southeast of the east end of the bridge; it is stamped 4,653.6 feet above sea level; the elevation of the bench mark above the datum of gage is 6.83 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, p 189; WS 16, p 140; 66, p 94; 85, p 42; 100, pp 64–65; 133, p 162.
Discharge: WS 85, p 43; 100, p 65; 133, p 163.
Discharge, monthly: WS 85, p 44; 100, p 67; 133, p 164.
Gage heights: WS 16, p 140; 66, p 95; 85, p 43; 100, p 66; 133, p 163.
Rating table: WS 85, p 44; 100, p 66; 133, p 164.

*Discharge measurements of Gunnison River at Whitewater, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 30 | R. I. Meeker | 246 | 487 | 2.17 | 4.25 | 1,059 |
| May 21 | do | 275 | 2,744 | 6.76 | 11.95 | 18,560 |
| May 22 | do | 275 | 2,797 | 7.22 | 12.15 | 20,210 |
| June 4 | do | 275 | 3,092 | 8.08 | 13.25 | 25,000 |
| July 12 | do | 262 | 978 | 2.68 | 5.62 | 2,622 |
| August 11 | do | 253 | 691 | 1.95 | 4.45 | 1,345 |
| September 28 | do | 205 | 513 | 1.66 | 3.90 | 824 |

*Daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | 4.3 | 9.4 | 11.65 | 7.7 | 6.4 | 4.0 | 4.65 |
| 2 | 4.3 | 10.1 | 12.45 | 7.35 | 6.15 | 4.05 | 4.65 |
| 3 | 4.35 | 9.6 | 12.75 | 7.1 | 5.65 | 3.9 | 4.45 |
| 4 | 4.25 | 8.85 | 13.15 | 6.85 | 5.3 | 3.95 | 4.35 |
| 5 | 4.4 | 8.35 | 13.85 | 6.55 | 5.15 | 4.6 | 4.25 |
| 6 | 4.25 | 7.75 | 13.6 | 6.45 | 5.05 | 4.4 | 4.2 |
| 7 | 4.2 | 7.65 | 13.05 | 6.25 | 5.05 | 4.45 | 4.25 |
| 8 | 4.5 | 7.95 | 13.2 | 6.05 | 4.95 | 4.35 | 4.15 |
| 9 | 4.85 | 8.7 | 13.5 | 6.05 | 4.75 | 4.25 | 4.05 |
| 10 | 5.1 | 8.8 | 13.55 | 5.95 | 4.6 | 4.2 | 4.0 |
| 11 | 5.55 | 8.35 | 12.95 | 5.8 | 4.45 | 4.05 | 3.95 |

*Daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1905*—Continued.

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 12 | 5.8 | 7.95 | 12.5 | 5.65 | 4.55 | 4.05 | 3.9 |
| 13 | 5.7 | 7.8 | 12.25 | 5.5 | 4.55 | 4.0 | 3.9 |
| 14 | 5.55 | 7.85 | 12.05 | 5.5 | 4.5 | 3.9 | 3.9 |
| 15 | 5.4 | 7.8 | 11.85 | 5.4 | 4.45 | 3.8 | 4.0 |
| 16 | 5.3 | 8.35 | 11.7 | 5.45 | 4.4 | 3.8 | 3.95 |
| 17 | 5.55 | 9.4 | 11.1 | 5.35 | 4.25 | 3.8 | 4.0 |
| 18 | 5.75 | 10.3 | 10.45 | 5.35 | 4.1 | 3.75 | 4.05 |
| 19 | 5.75 | 10.9 | 10.15 | 5.15 | 4.0 | 3.7 | 4.2 |
| 20 | 5.9 | 11.6 | 9.9 | 5.15 | 3.95 | 3.7 | 4.15 |
| 21 | 5.75 | 11.95 | 9.6 | 5.1 | 3.9 | 3.75 | 4.15 |
| 22 | 5.5 | 12.15 | 9.35 | 5.1 | 3.8 | 3.75 | 4.0 |
| 23 | 5.65 | 12.6 | 9.15 | 5.1 | 3.7 | 3.75 | 4.3 |
| 24 | 5.75 | 12.75 | 9.05 | 5.05 | 3.85 | 3.7 | 4.3 |
| 25 | 6.05 | 12.55 | 8.8 | 4.85 | 3.8 | 3.8 | 4.25 |
| 26 | 6.4 | 12.45 | 8.75 | 4.65 | 3.85 | 3.95 | 4.3 |
| 27 | 6.7 | 12.35 | 8.5 | 4.7 | 3.95 | 3.95 | 4.25 |
| 28 | 7.35 | 12.05 | 8.4 | 4.7 | 3.85 | 3.9 | 4.3 |
| 29 | 8.1 | 11.3 | 8.2 | 4.65 | 3.8 | 4.35 | 4.25 |
| 30 | 8.65 | 10.65 | 8.0 | 5.0 | 3.95 | 4.55 | 4.25 |
| 31 | ........ | 10.95 | ........ | 5.8 | 4.05 | ........ | 4.25 |

*Station rating table for Gunnison River at Whitewater, Colo., from April 1 to May 1, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.00 | 695 | 5.20 | 1,860 | 6.40 | 3,530 | 7.60 | 5,610 |
| 4.10 | 765 | 5.30 | 1,985 | 6.50 | 3,690 | 7.70 | 5,800 |
| 4.20 | 840 | 5.40 | 2,110 | 6.60 | 3,850 | 7.80 | 5,990 |
| 4.30 | 920 | 5.50 | 2,240 | 6.70 | 4,010 | 7.90 | 6,190 |
| 4.40 | 1,005 | 5.60 | 2,370 | 6.80 | 4,180 | 8.00 | 6,400 |
| 4.50 | 1,095 | 5.70 | 2,505 | 6.90 | 4,350 | 8.20 | 6,830 |
| 4.60 | 1,190 | 5.80 | 2,640 | 7.00 | 4,520 | 8.40 | 7,300 |
| 4.70 | 1,290 | 5.90 | 2,780 | 7.10 | 4,690 | 8.60 | 7,810 |
| 4.80 | 1,395 | 6.00 | 2,920 | 7.20 | 4,870 | 8.80 | 8,350 |
| 4.90 | 1,505 | 6.10 | 3,070 | 7.30 | 5,050 | 9.00 | 8,910 |
| 5.00 | 1,620 | 6.20 | 3,220 | 7.40 | 5,230 | 9.20 | 9,490 |
| 5.10 | 1,740 | 6.30 | 3,370 | 7.50 | 5,420 | 9.40 | 10,090 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5 Below 7.8 feet the table is the same as for 1904.

*Station rating table for Gunnison River at Whitewater, Colo., from May 2 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.70 | 720 | 5.20 | 2,085 | 6.70 | 4,280 | 9.40 | 10,180 |
| 3.80 | 795 | 5.30 | 2,205 | 6.80 | 4,450 | 9.60 | 10,750 |
| 3.90 | 870 | 5.40 | 2.330 | 6.90 | 4,625 | 9.80 | 11,340 |
| 4.00 | 950 | 5.50 | 2,460 | 7.00 | 4,800 | 10.00 | 11,960 |
| 4.10 | 1,030 | 5.60 | 2,590 | 7.20 | 5,160 | 10.20 | 12,600 |
| 4.20 | 1,115 | 5.70 | 2,725 | 7.40 | 5,540 | 10.40 | 13,250 |
| 4.30 | 1,200 | 5.80 | 2,865 | 7.60 | 5,930 | 10.60 | 13,920 |
| 4.40 | 1,290 | 5.90 | 3,010 | 7.80 | 6,340 | 10.80 | 14,610 |
| 4.50 | 1,380 | 6.00 | 3,160 | 8.00 | 6,760 | 11.00 | 15,320 |
| 4.60 | 1,470 | 6.10 | 3,310 | 8.20 | 7,200 | 11.50 | 17,180 |
| 4.70 | 1,565 | 6.20 | 3,465 | 8.40 | 7,650 | 12.00 | 19,240 |
| 4.80 | 1,660 | 6.30 | 3,620 | 8.60 | 8,120 | 12.50 | 21,520 |
| 4.90 | 1,760 | 6.40 | 3,780 | 8.80 | 8,600 | 13.00 | 23,920 |
| 5.00 | 1,860 | 6.50 | 3,945 | 9.00 | 9,100 | 13.50 | 26,370 |
| 5.10 | 1,970 | 6.60 | 4,110 | 9.20 | 9,630 | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905, and is fairly well defined.

*Estimated monthly discharge of Gunnison River at Whitewater, Colo., for 1905.*

[Drainage area, 7,868 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 7,945 | 840 | 2,494 | 148,400 | .317 | .354 |
| May | 22,710 | 6,030 | 12,720 | 782,100 | 1.62 | 1.87 |
| June | 28,080 | 6,760 | 16,810 | 1,000,000 | 2.14 | 2.39 |
| July | 6,130 | 1,518 | 2,783 | 171,100 | .354 | .408 |
| August | 3,780 | 720 | 1,429 | 87,860 | .182 | .210 |
| September | 1,470 | 720 | 962 | 57,240 | .122 | .136 |
| October | 1,518 | 870 | 1,103 | 67,820 | .140 | .161 |
| The period | | | | 2,315,000 | | |

## NORTH FORK OF GUNNISON RIVER NEAR HOTCHKISS, COLO.

This station was established April 13, 1904. It is located 4 miles below Hotchkiss, Colo., on the ranch of L. Gorsuch, and replaces the station maintained during 1903 at the highway bridge one-half mile east of Hotchkiss and abandoned because of unsatisfactory conditions.

The channel is 180 feet wide and is straight for 800 feet both above and below the station. The banks are composed of alluvial material and are not liable to overflow. The bed of the stream is composed of large and small cobblestones, with some gravel, and changes only during extreme high water. There are two channels at low water, divided by a bar; at high stages there is but one channel. The current is swift at all stages. Gage heights range from 1 foot to 6 feet.

Discharge measurements are made by means of a cable and car, the property of the observer. The initial point for soundings is near the left end of the cable and is marked "zero" on the tag line. A stay line 40 feet upstream is used during high water.

The gage, which was observed during 1905 by L. Gorsuch, is an inclined timber, graduated from zero to 7 feet, and is located on the right bank about 800 feet downstream from the cable. The bench mark is a point on a large bowlder on the right bank of the stream about 50 feet to the right of the gage, designated by a circle of white paint and marked "B. M.;" elevation above the zero of the gage, 9.34 feet.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 167–170.

*Discharge measurements of North Fork of Gunnison River near Hotchkiss, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 11 | R. I. Meeker | 160 | 204 | 3.78 | 3.10 | 771 |
| May 7 | Oro McDermith | 164 | 365 | 4.94 | 3.95 | 1,802 |
| May 20 | A. A. Weiland | 175 | 714 | 7.80 | 5.40 | 5,570 |
| June 2 | ....do | 175 | 698 | 8.12 | 5.30 | 5.671 |
| June 14 | ....do | 170 | 583 | 6.59 | 4.70 | 3,843 |
| June 28 | ....do | 170 | 374 | 4.49 | 3.60 | 1,682 |
| July 12 | ....do | 143 | 187 | 3.42 | 2.60 | 639 |
| August 2 | ....do | 115 | 122 | 2.52 | 2.2 | 308 |
| October 3 | R. I. Meeker | 65 | 48 | 2.35 | 1.78 | 113 |

*Daily gage height, in feet, of North Fork of Gunnison River near Hotchkiss, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 2.3 | 2.6 | 2.52 | 5.0 | 5.45 | 3.25 | 2.45 | 1.28 | 1.88 | 1.8 | 1.75 |
| 2 | 2.3 | 2.32 | 2.75 | 2.6 | 5.32 | 5.55 | 3.2 | 2.3 | 1.18 | 1.8 | 1.8 | 1.7 |
| 3 | 2.3 | 2.35 | 2.8 | 2.58 | 4.65 | 5.45 | 3.02 | 2.18 | 1.15 | 1.78 | 1.75 | 1.7 |
| 4 | 2.3 | 2.4 | 2.7 | 2.55 | 4.2 | 5.8 | 2.95 | 2.1 | 1.20 | 1.7 | 1.75 | 1.7 |
| 5 | 2.35 | 2.4 | 2.6 | 2.55 | 4 05 | 5.95 | 2.95 | 2.05 | 1.25 | 1.7 | 1.7 | 1.75 |
| 6 | 2.35 | 2.4 | 2.6 | 2.65 | 3.85 | 5.45 | 2.9 | 2.0 | 1.32 | 1.7 | 1.7 | 1.75 |
| 7 | 2.38 | 2.35 | 2.6 | 2.85 | 3.92 | 5.45 | 2.82 | 2.0 | 1.42 | 1.7 | 1.7 | 1.75 |
| 8 | 2.4 | 2.3 | 2.58 | 3.02 | 4.35 | 5.45 | 2.85 | 1.92 | 1.48 | 1.68 | 1.7 | 1.8 |
| 9 | 2.4 | 2.25 | 2.5 | 3.15 | 4.75 | 5.7 | 2.75 | 1.88 | 1.4 | 1.65 | 1.7 | 1.8 |
| 10 | 2.4 | 2.25 | 2.5 | 3.28 | 4.35 | 5.45 | 2.72 | 1.78 | 1.35 | 1.65 | 1.7 | 1.82 |
| 11 | 2.4 | 2.25 | 2.5 | 3.3 | 4.1 | 5.25 | 2.62 | 1.78 | 1.32 | 1.65 | 1.7 | 1.82 |
| 12 | 2.38 | 2.25 | 2.5 | 3.35 | 4.15 | 5.1 | 2.58 | 1.82 | 1.25 | 1.65 | 1.65 | 1.88 |
| 13 | 2.35 | 2.2 | 2.5 | 3.35 | 4.25 | 5.05 | 2.52 | 1.88 | 1.25 | 1.65 | 1.65 | 1.88 |
| 14 | 2.35 | 2.2 | 2.5 | 3.35 | 4.15 | 4.95 | 2.5 | 1.82 | 1.25 | 1.7 | 1.65 | 1.88 |
| 15 | 2.32 | 2.2 | 2.58 | 3.25 | 4.25 | 4.9 | 2.48 | 1.78 | 1.25 | 1.7 | 1.72 | 1.92 |
| 16 | 2.3 | 2.2 | 2.65 | 3.32 | 4.6 | 4.7 | 2.42 | 1.72 | 1.25 | 1.7 | 1.75 | 1.92 |
| 17 | 2.3 | 2.2 | 2.68 | 3.32 | 5.08 | 4.5 | 2.4 | 1.62 | 1.25 | 1.75 | 1.8 | 1.95 |
| 18 | 2.35 | 2.25 | 2.7 | 3.35 | 5.38 | 4.35 | 2.32 | 1.52 | 1.3 | 1.78 | 1.8 | 1.95 |
| 19 | 2.35 | 2.28 | 2.6 | 3.52 | 5.6 | 4.15 | 2.3 | 1.42 | 1.32 | 1.68 | 1.75 | 1.95 |
| 20 | 2.3 | 2.3 | 2.62 | 3.35 | 5.7 | 4.02 | 2.3 | 1.42 | 1.3 | 1.65 | 1.7 | 1.95 |
| 21 | 2.2 | 2.3 | 2.62 | 3.28 | 5.7 | 3.95 | 2.22 | 1.4 | 1.3 | 1.6 | 1.65 | 2.05 |
| 22 | 2.2 | 2.32 | 2.58 | 3.32 | 5.9 | 3.78 | 2.2 | 1.35 | 1.3 | 1.65 | 1.68 | 2.05 |
| 23 | 2.2 | 2.25 | 2.52 | 3.32 | 6.0 | 3.72 | 2.18 | 1.3 | 1.3 | 1.72 | 1.82 | 2.05 |
| 24 | 2.2 | 2.25 | 2.5 | 3.55 | 6.0 | 3.72 | 2.1 | 1.22 | 1.32 | 1.8 | 1.78 | 2.15 |
| 25 | 2.25 | 2.28 | 2.5 | 3.68 | 5.7 | 3.7 | 2.08 | 1.2 | 1.42 | 1.75 | 1.68 | 2.15 |
| 26 | 2.25 | 2.28 | 2.5 | 3.62 | 5.7 | 3.6 | 2.05 | 1.22 | 1.48 | 1.7 | 1.78 | 2.15 |
| 27 | 2.3 | 2.25 | 2.6 | 3.82 | 5.65 | 3.5 | 2.0 | 1.4 | 1.5 | 1.7 | 1.95 | 2.22 |
| 28 | 2.35 | 2.3 | 2.58 | 4.2 | 5.55 | 3.55 | 1.98 | 1.42 | 1.5 | 1.7 | 2.0 | 2.2 |
| 29 | 2.35 | ....... | 2.52 | 4.4 | 4.95 | 3.42 | 1.95 | 1.4 | 1.55 | 1.7 | 1.85 | 2.2 |
| 30 | 2.35 | ....... | 2.5 | 4.65 | 4.65 | 3.35 | 2.1 | 1.35 | 1.82 | 1.72 | 1.8 | 2.2 |
| 31 | 2.35 | ....... | 2.52 | ....... | 5.25 | ....... | 2.45 | 1.35 | ..... | 1.8 | ....... | 2.25 |

NOTE.—No ice record.

*Station rating table for North Fork of Gunnison River near Hotchkiss, Colo., from January 1 to May 16, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.20 | 120 | 3.10 | 790 | 4.00 | 2,200 | 4.90 | 4,290 |
| 2.30 | 150 | 3.20 | 920 | 4.10 | 2,400 | 5.00 | 4,570 |
| 2.40 | 190 | 3.30 | 1,050 | 4.20 | 2,610 | 5.10 | 4,850 |
| 2.50 | 240 | 3.40 | 1,190 | 4.30 | 2,820 | 5.20 | 5,140 |
| 2.60 | 300 | 3.50 | 1,340 | 4.40 | 3,040 | 5.30 | 5,440 |
| 2.70 | 370 | 3.60 | 1,500 | 4.50 | 3,270 | 5.40 | 5,740 |
| 2.80 | 460 | 3.70 | 1,660 | 4.60 | 3,510 | | |
| 2.90 | 560 | 3.80 | 1,830 | 4.70 | 3,760 | | |
| 3.00 | 670 | 3.90 | 2,010 | 4.80 | 4,020 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined between gage heights 2.2 feet and 3.1 feet. Above gage height 3.5 the table is uncertain.

*Station rating table for North Nork of Gunnison River near Hotchkiss, Colo., from May 17 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 0 | 2.10 | 260 | 3.20 | 1,280 | 4.60 | 3,680 |
| 1.10 | 2 | 2.20 | 320 | 3.30 | 1,410 | 4.80 | 4,150 |
| 1.20 | 8 | 2.30 | 390 | 3.40 | 1,540 | 5.00 | 4,640 |
| 1.30 | 18 | 2.40 | 460 | 3.50 | 1,680 | 5.20 | 5,140 |
| 1.40 | 32 | 2.50 | 540 | 3.60 | 1,830 | 5.40 | 5,660 |
| 1.50 | 50 | 2.60 | 630 | 3.70 | 1,980 | 5.60 | 6,190 |
| 1.60 | 75 | 2.70 | 720 | 3.80 | 2,140 | 5.80 | 6,740 |
| 1.70 | 105 | 2.80 | 820 | 3.90 | 2,310 | 6.00 | 7,300 |
| 1.80 | 135 | 2.90 | 930 | 4.00 | 2,480 | | |
| 1.90 | 170 | 3.00 | 1,040 | 4.20 | 2,850 | | |
| 2.00 | 210 | 3.10 | 1,160 | 4.40 | 3,250 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined above gage height 1.7 feet.

*Estimated monthly discharge of North Fork of Gunnison River near Hotchkiss, Colo., for 1905.*

[Drainage area, 850 square miles.]

| Month. | Discharge in second-feet | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 190 | 120 | 159 | 9,777 | 0.187 | 0.216 |
| February | 190 | 120 | 146 | 8,108 | .172 | .179 |
| March | 460 | 240 | 292 | 17,950 | .344 | .397 |
| April | 3,635 | 252 | 1,162 | 69,140 | 1.37 | 1.53 |
| May | 7,300 | 1,920 | 4,476 | 275,200 | 5.27 | 6.08 |
| June | 7,160 | 1,475 | 3,986 | 237,200 | 4.69 | 5.23 |
| July | 1,345 | 190 | 577 | 35,480 | .679 | .783 |
| August | 500 | 8 | 125 | 7,686 | .147 | .170 |
| September | 142 | 5 | 27.5 | 1,636 | .032 | .036 |
| October | 163 | 75 | 108 | 6,641 | .127 | .146 |
| November | 210 | 90 | 121 | 7,200 | .142 | .158 |
| December | 355 | 105 | 199 | 12,240 | .234 | .270 |
| The year | 7,300 | 5 | 948 | 688,300 | 1.12 | 15.20 |

## CIMARRON CREEK AT CIMARRON, COLO.

Cimarron Creek rises in the extreme southwestern part of Gunnison County and flows northward to its point of junction with Gunnison River. The drainage area is entirely mountainous. During the summer and fall short, heavy rainstorms occur frequently, and the rapid run-off induced by the steep slopes of the basin causes sudden fluctuations in gage heights.

The gaging station was established April 28, 1903. It is located at Smith's private bridge, 1,000 feet south of the Denver and Rio Grande Railroad station at Cimarron, in T. 48 N., R. 6 W., and about 1 mile above the mouth of Cimarron Creek.

The channel is straight for 100 feet above and 250 feet below the bridge. Both banks are low, rocky, and partly wooded and have not been known to overflow during the past ten years. The bed of the stream is composed of bowlders and cobblestones and is very rough, but is stable. The gradient is steep, though somewhat uneven. At low water there is but one channel. At high water there are two channels divided by the central pier of the bridge. The current is always rapid. Gage heights range from 1.5 to 4 feet. Accurate measurements are difficult to secure on account of the roughness of the section and the swift and irregular velocities.

Discharge measurements are made from the downstream side of the footbridge, which is supported by two log abutments and one log crib pier in the center of the stream. The initial point for soundings is the left abutment on the downstream side and is marked zero on the bridge. The bridge was washed away in June, 1905, but was replaced shortly afterwards at a greater elevation.

The gage, which was read during 1905 by J. L. Linscott, is a vertical staff graduated from zero to 6 feet, spiked to the face of the left abutment of the bridge on the downstream side. The bench mark consists of two nails driven into the root of a cottonwood tree 50 feet west of gage; elevation above the zero of the gage, 8.24 feet. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 82-83; 133, p 165.
Discharge: 66, p 55; 85, p 77; 100, pp 83, 94; 133, p 165.
Discharge, monthly: 100, p 84; 133, p 167.
Gage heights: 100, pp 83-84; 133, p 166.
Rating table: 100, p 84; 133, p 166.

*Discharge measurements of Cimarron Creek at Cimarron, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 1 | R. I. Meeker | 32 | 20 | 2.20 | 1.70 | 44 |
| May 11 | Oro McDermith | 39 | 45 | 3.33 | 2.30 | 153 |
| May 23 | A. A. Weiland | 47 | 108 | 6.67 | 3.50 | 720 |
| May 23 | R. I. Meeker | 48 | 103 | 6.65 | 3.48 | 685 |
| June 6 | A. A. Weiland | 47 | 140 | 7.76 | 4.20 | 1,087 |
| June 19 | do | 62 | 103 | 5.99 | 3.45 | 617 |
| July 18 | do | 33 | 28 | 3.00 | 2.00 | 84 |
| August 11 | do | 35 | 23 | 2.30 | 1.85 | 53 |
| October 5 | R. I. Meeker | 24 | 18 | 1.72 | 1.65 | 31 |

*Daily gage height, in feet, of Cimarron Creek at Cimarron, Colo., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.95 | 2.65 | 3.7 | 2.85 | 2.5 | 1.63 | 1.77 | 1.63 | 1.55 |
| 2 | ........ | 1.68 | 2.82 | 3.85 | 2.77 | 2.3 | 1.6 | 1.87 | 1.65 | ........ |
| 3 | ........ | 1.68 | 2.5 | 3.92 | 2.75 | 2.25 | 1.63 | 1.65 | 1.65 | ........ |
| 4 | ........ | 1.75 | 2.38 | 4.1 | 2.5 | 2.17 | 1.6 | 1.9 | 1.63 | ........ |
| 5 | ........ | 1.68 | 2.35 | 4.25 | 2.6 | 2.1 | 1.63 | 1.65 | 1.65 | ........ |
| 6 | ........ | 1.68 | 2.28 | 4.1 | 2.55 | 2.07 | 1.73 | 1.65 | 1.65 | ........ |
| 7 | ........ | 1.65 | 2.2 | 4.1 | 2.55 | 2.0 | 1.63 | 1.63 | 1.57 | ........ |
| 8 | ........ | 1.78 | 2.2 | 4.08 | 2.55 | 2.05 | 1.57 | 1.6 | 1.55 | ........ |
| 9 | ........ | 1.82 | 2.62 | 4.12 | 2.4 | 1.8 | 1.6 | 1.65 | 1.57 | ........ |
| 10 | 1.8 | 1.82 | 2.28 | 4.03 | 2.45 | 1.7 | 1.57 | 1.65 | 1.55 | ........ |
| 11 | 1.6 | 1.82 | 2.3 | 4.0 | 2.4 | 1.85 | 1.6 | 1.6 | 1.53 | ........ |
| 12 | 1.75 | 1.78 | 2.28 | 3.91 | 2.35 | 1.8 | 1.6 | 1.55 | 1.53 | ........ |
| 13 | 1.72 | 1.72 | 2.38 | 3.82 | 2.3 | 1.8 | 1.6 | 1.57 | 1.57 | ........ |
| 14 | 1.75 | 1.75 | 2.3 | 3.8 | 2.25 | 1.77 | 1.63 | 1.55 | 1.6 | ........ |
| 15 | 1.78 | 1.65 | 2.42 | 3.87 | 2.3 | 1.73 | 1.5 | 1.6 | 1.57 | ........ |
| 16 | 1.78 | 1.7 | 2.85 | 3.65 | 2.15 | 1.7 | 1.47 | 1.6 | 1.57 | ........ |
| 17 | 1.75 | 1.82 | 2.95 | 3.52 | 2.1 | 1.67 | 1.5 | 1.63 | 1.6 | ........ |
| 18 | 1.78 | 1.82 | 3.0 | 3.53 | 2.0 | 1.7 | 1.63 | 1.6 | 1.57 | ........ |
| 19 | 1.8 | 1.85 | 3.1 | 3.37 | 2.13 | 1.57 | 1.63 | 1.63 | 1.53 | ........ |
| 20 | 1.82 | 1.78 | 3.1 | 3.33 | 2.3 | 1.63 | 1.57 | 1.6 | 1.57 | ........ |
| 21 | 1.72 | 1.68 | 3.28 | 3.3 | 2.15 | 1.6 | 1.55 | 1.6 | 1.53 | ........ |
| 22 | 1.8 | 1.78 | 3.55 | 3.3 | 2.15 | 1.6 | 1.63 | 1.63 | 1.55 | ........ |
| 23 | 1.7 | 1.82 | 3.65 | 3.13 | 2.03 | 1.63 | 1.63 | 1.87 | 1.55 | ........ |
| 24 | 1.78 | 1.78 | 3.4 | 3.2 | 1.9 | 1.63 | 1.63 | 1.63 | 1.5 | ........ |
| 25 | 1.8 | 1.8 | 3.3 | 3.23 | 2.1 | 1.63 | 1.77 | 1.53 | 1.55 | ........ |
| 26 | 1.72 | 1.85 | 3.5 | 3.1 | 2.1 | 1.6 | 1.67 | 1.63 | 1.53 | ........ |
| 27 | 1.8 | 1.92 | 3.55 | 3.07 | 2.2 | 1.6 | 1.63 | 1.65 | 1.63 | ........ |
| 28 | 1.75 | 2.25 | 3.5 | 3.05 | 2.15 | 1.63 | 1.7 | 1.63 | 1.57 | ........ |
| 29 | 1.75 | 2.3 | 3.22 | 2.97 | 2.95 | 1.65 | 1.77 | 1.65 | 1.55 | ........ |
| 30 | 1.78 | 2.4 | 3.2 | 2.95 | 2.85 | 1.7 | 2.05 | 1.65 | 1.55 | ........ |
| 31 | 1.8 | ........ | 3.45 | ........ | 2.73 | 1.73 | ........ | 1.7 | ........ | ........ |

**Note.—River frozen during December.**

*Station rating table for Cimarron Creek at Cimarron, Colo., from March 10 to December 1, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 22 | 2.30 | 152 | 3.10 | 473 | 3.90 | 973 |
| 1.60 | 28 | 2.40 | 181 | 3.20 | 526 | 4.00 | 1,050 |
| 1.70 | 37 | 2.50 | 213 | 3.30 | 582 | 4.10 | 1,130 |
| 1.80 | 49 | 2.60 | 247 | 3.40 | 640 | 4.20 | 1,213 |
| 1.90 | 65 | 2.70 | 285 | 3.50 | 700 | 4.30 | 1,300 |
| 2.00 | 83 | 2.80 | 327 | 3.60 | 763 | | |
| 2.10 | 105 | 2.90 | 373 | 3.70 | 830 | | |
| 2.20 | 126 | 3.00 | 422 | 3.80 | 900 | | |

**Note.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1905. It is well defined between gage heights 1.7 feet and 3.5 feet.**

*Estimated monthly discharge of Cimarron Creek at Cimarron, Colo., for 1905.*

[Drainage area, 210 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 10–31 | 52 | 28 | 44.5 | 1,942 | .212 | .173 |
| April | 181 | 32 | 57.5 | 3,422 | .274 | .305 |
| May | 796 | 126 | 389 | 23,920 | 1.85 | 2.13 |
| June | 1,256 | 397 | 796 | 47,360 | 3.79 | 4.23 |
| July | 397 | 65 | 185 | 11,380 | .881 | 1.02 |
| August | 213 | 26 | 59.4 | 3,652 | .283 | .326 |
| September | 93 | 20 | 32.4 | 1,928 | .154 | .172 |
| October | 65 | 24 | 33.4 | 2,054 | .159 | .183 |
| November | 32 | 22 | 26.7 | 1,589 | .127 | .1 2 |
| The period | | | | 97,250 | | |

## UNCOMPAHGRE RIVER NEAR COLONA, COLO.

This station was established April 9, 1904. It is located at the private road bridge of J. M. Duckett, in T. 47 N., R. 8 W., one-half mile above Eldredge siding on the Denver and Rio Grande Railroad and 3 miles above Colona, Colo. It is best reached by driving from Montrose. The station replaces one that was established August 10, 1903, at Kettle's bridge, 1 mile south of Colona, to take the place of the original station, which was located one-half mile northeast of Colona. Both of these stations were abandoned because of unsatisfactory conditions.

The channel is straight for about 300 feet above and below the station. The banks are about 4 feet high, are rocky and partly wooded, and neither is subject to overflow. The bed of the stream is composed of large and small cobblestones, and a loose deposit of silt shifts along each side. There is but one channel at all stages and the current is swift. Gage heights range from 0.5 foot to 4 feet. Accurate measurements are difficult to secure on account of the rough bed and steep gradient of the channel.

Discharge measurements are made from the downstream side of the 46.2-foot single-span bridge to which the gage is attached. The initial point for soundings is the downstream edge of the left abutment.

The gage, which was read during 1905 by Miss Clara Duckett, is an 8-foot board graduated from zero to 7 feet. It was spiked vertically to the upstream side of the left abutment. The high water of June, 1905, caused the pier to sink 0.18 foot during July, and on August 14, 1905, the gage was moved to the downstream side of the left pier and set at the original datum. The bench mark is the upper edge of a large screw set about 3 feet above the ground in an 8-inch willow tree 75 feet south and upstream from the right end of the bridge; elevation, 9.97 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 72–73; 133, pp 171–172.
Discharge: 100, p. 73; 133, p 172.
Discharge, monthly: 100, p 75; 133, p 174.
Gage heights: 100, p 74; 133, p 173.
Rating tables: 100, pp 74–75; 133, pp 173–174

*Discharge measurements of Uncompahgre River near Colona, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft* |
| April 13 | R. I. Meeker | 46 | 49 | 2.84 | 1.10 | 139 |
| May 3 | Oro McDermith | 47 | 91 | 4.27 | 1.90 | 389 |
| May 18 | A. A. Weiland | 47 | 110 | 4.88 | 2.30 | 537 |
| May 29 | do | 47 | 114 | 4.94 | 2.20 | 564 |
| June 8 | do | 47 | 170 | 8.15 | 3.75 | 1,384 |
| June 21 | do | 47 | 129 | 6.38 | 2.80 | 822 |
| July 8 | do | 47 | 98 | 4.95 | 2.12 | 485 |
| July 24 | do | 47 | 76 | 3.92 | 1.72 | 298 |
| August 7 | do | 47 | 73 | 3.96 | 1.72 | 289 |
| August 14 | do | 47 | 63 | 3.39 | 1.40 | 214 |
| October 1 | R. I. Meeker | 43 | 57 | 3.25 | 1.56 | 185 |

*Daily gage height, in feet, of Uncompahgre River near Colona, Colo., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.2 | 1.05 | 2.2 | 2.95 | 2.62 | 1.87 | 1.2 | 1.47 | 1.06 | 0.96 |
| 2 | | 1.15 | 1.1 | 2.25 | 3.25 | 2.42 | 1.97 | 1.2 | 1.22 | 1.11 | .96 |
| 3 | | 1.15 | 1.0 | 1.9 | 3.4 | 2.32 | 1.97 | 1.2 | 1.27 | 1.11 | |
| 4 | | 1.0 | .95 | 1.85 | 4.2 | 2.27 | 1.82 | 1.3 | 1.22 | 1.11 | |
| 5 | 0.7 | 1.1 | .95 | 1.75 | 4.1 | 2.22 | 1.82 | 1.35 | 1.27 | 0.96 | |
| 6 | .75 | 1.05 | 1.0 | 1.7 | 4.0 | 2.07 | 1.82 | 1.3 | 1.27 | 1.01 | |
| 7 | .75 | 1.0 | 1.05 | 1.65 | 4.0 | 1.82 | 1.72 | 1.3 | 1.27 | .96 | |
| 8 | .7 | 1.0 | 1.15 | 1.75 | 4.1 | 1.82 | 1.72 | 1.3 | 1.22 | 1.01 | |
| 9 | .7 | 1.0 | 1.2 | 1.9 | 4.2 | 1.92 | 1.72 | 1.3 | 1.22 | 1.01 | |
| 10 | .7 | 1.0 | 1.3 | 1.75 | 4.0 | 1.92 | 1.62 | 1.3 | 1.22 | .96 | |
| 11 | .7 | 1.0 | 1.3 | 1.7 | 4.0 | 1.87 | 1.52 | 1.15 | 1.12 | 1.01 | |
| 12 | | 1.0 | 1.3 | 1.75 | 4.0 | 1.82 | 1.47 | 1.15 | 1.12 | 1.01 | |
| 13 | | 1.0 | 1.15 | 1.8 | 4.1 | 1.82 | 1.47 | 1.2 | 1.17 | .96 | |
| 14 | | 1.0 | 1.0 | 1.7 | 4.05 | 1.92 | 1.6 | 1.2 | 1.12 | .96 | |
| 15 | | .9 | 1.0 | 1.8 | 4.0 | 2.02 | 1.6 | 1.15 | 1.07 | 1.01 | |
| 16 | | .9 | 1.0 | 2.15 | 3.8 | 1.82 | 1.6 | 1.25 | 1.22 | .96 | |
| 17 | | .9 | 1.2 | 2.6 | 3.4 | 1.82 | 1.4 | 1.1 | 1.22 | .96 | |
| 18 | | .95 | 1.2 | 2.65 | 3.5 | 1.82 | 1.4 | 1.15 | 1.22 | 1.01 | |
| 19 | .8 | 1.0 | 1.4 | 2.55 | 3.0 | 1.87 | 1.35 | 1.15 | 1.22 | 1.01 | |
| 20 | .8 | 1.0 | 1.35 | 2.55 | 3.4 | 2.02 | 1.2 | 1.2 | 1.22 | .96 | |
| 21 | .85 | 1.0 | 1.35 | 2.5 | 3.2 | 1.87 | 1.2 | 1.1 | 1.22 | .96 | |
| 22 | .85 | .95 | 1.2 | 2.9 | 2.95 | 1.87 | 1.2 | 1.15 | 1.12 | 1.01 | |
| 23 | .9 | 1.0 | 1.7 | 2.9 | 3.0 | 1.72 | 1.1 | 1.15 | 1.12 | .96 | |
| 24 | .9 | 1.15 | 1.2 | 2.9 | 3.0 | 1.82 | 1.1 | 1.0 | 1.22 | 1.06 | |
| 25 | .9 | 1.0 | 1.3 | 2.9 | 3.0 | 1.72 | 1.1 | 1.05 | 1.17 | 1.06 | |
| 26 | .8 | 1.0 | 1.45 | 2.75 | 3.0 | 1.72 | 1.1 | 1.0 | 0.97 | 1.06 | |
| 27 | .8 | 1.0 | 1.75 | 2.8 | 3.0 | 1.87 | 1.1 | 1.0 | 1.02 | .96 | |
| 28 | .9 | 1.0 | 1.9 | 2.75 | 3.0 | 1.97 | 1.25 | 1.15 | 1.07 | .96 | |
| 29 | | 1.0 | 2.1 | 2.3 | 2.95 | 2.47 | 1.15 | 1.3 | 1.12 | 1.01 | |
| 30 | | .9 | 2.1 | 2.2 | 2.8 | 2.87 | 1.35 | 1.15 | 1.12 | 1.01 | |
| 31 | | .9 | | 2.65 | | 2.47 | 1.45 | | 1.17 | | |

NOTE.—River frozen February 12-18.

*Station rating table for Uncompahgre River near Colona, Colo., from February 5 to December 2, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.70 | 75 | 1.60 | 275 | 2.50 | 645 | 3.40 | 1,165 |
| .80 | 85 | 1.70 | 310 | 2.60 | 695 | 3.50 | 1,235 |
| .90 | 100 | 1.80 | 345 | 2.70 | 750 | 3.60 | 1,305 |
| 1.00 | 120 | 1.90 | 380 | 2.80 | 805 | 3.70 | 1,380 |
| 1.10 | 140 | 2.00 | 420 | 2.90 | 860 | 3.80 | 1,460 |
| 1.20 | 165 | 2.10 | 460 | 3.00 | 920 | 3.90 | 1,540 |
| 1.30 | 190 | 2.20 | 505 | 3.10 | 980 | 4.00 | 1,625 |
| 1.40 | 215 | 2.30 | 550 | 3.20 | 1,040 | 4.10 | 1,710 |
| 1.50 | 245 | 2.40 | 595 | 3.30 | 1,100 | 4.20 | 1,800 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is fairly well defined between gage heights 1.2 feet and 3.8 feet.

*Estimated monthly discharge of Uncompahgre River near Colona, Colo., for 1905.*

[Drainage area, 433 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| February, 17 days | 100 | 75 | 85.8 | 2,893 | 0.198 | 0.125 |
| March | 165 | 100 | 122 | 7,501 | .282 | .325 |
| April | 460 | 110 | 197 | 11,720 | .455 | .508 |
| May | 860 | 293 | 543 | 33,390 | 1.25 | 1.44 |
| June | 1,800 | 805 | 1,279 | 76,110 | 2.95 | 3.29 |
| July | 844 | 317 | 436 | 26,810 | 1.01 | 1.16 |
| August | 408 | 140 | 246 | 15,130 | .568 | .655 |
| September | 202 | 120 | 161 | 9,580 | .372 | .415 |
| October | 236 | 114 | 161 | 9,900 | .372 | .429 |
| November | 143 | 112 | 121 | 7,200 | .279 | .311 |
| The period | | | | 200,200 | | |

## UNCOMPAHGRE RIVER AT MONTROSE, COLO.

This station was established April 22, 1903. It is located at the iron highway bridge west of Montrose and one-fourth mile west of the Denver and Rio Grande Railroad near Haskell Park.

The channel is straight for 100 feet above and 300 feet below the bridge. The right bank is of earth; the left bank is of earth below the bridge, but above the bridge is the steep slope of a shale bluff. Both banks are liable to overflow at extreme high water. The bed of the stream is composed of cobblestones and gravel and is quite rough. There is but one channel at all stages, broken during high water by the left pier of the bridge. The higher portion of the left side of the channel is covered with undergrowth which obstructs the flow during high stages. The current is rapid at all times. Gage heights range from 2 to 6 feet.

Discharge measurements are made from either side of the bridge. The initial point for soundings is at the inner edge of the lower cylinder bridge pier at the right bank.

The gage, which was read twice daily during 1905 by Herbert Reeves, is a vertical staff, graduated from zero to 8 feet, spiked to a wing dam 20 feet above the bridge. The zero of this gage, which was established April 15, 1904, is 1.45 feet higher than that of the original gage which it replaced. The bench mark consists of two nails driven into a blaze on the root of a cottonwood tree 50 feet to the right of the gage; elevation, 8.61 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 50, p 379–380; 100, p 70; 133, p 175.
Discharge: WS 50, p 380; 66, p 98; 100, p 70; 133, p 175.
Discharge, monthly: Ann 22, iv, p 392; WS 100, p 72; 133, p 177.
Gage heights: WS 11, p 69; 50, p 380; 100, p 71; 133, p 176.
Rating tables: WS 52, p 520; 100, pp 71-72; 133, p 176.

*Discharge measurements of Uncompahgre River at Montrose, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 13 | R. I. Meeker | 35 | 40 | 2.72 | 2.40 | 109 |
| May 9 | Oro McDermith | 37 | 66 | 4.21 | 3.22 | 278 |
| May 25 | A. A. Weiland | 43 | 120 | 5.64 | 4.30 | 677 |
| June 4 | R. I. Meeker | 91 | 218 | 6.78 | 5.38 | 1,479 |
| June 24 | A. A. Weiland | 40 | 96 | 5.33 | 3.73 | 512 |
| July 3 | do | 35 | 64 | 2.89 | 2.57 | 185 |
| July 21 | do | 32 | 48 | 1.98 | 2.05 | 95 |
| August 8 | do | 35 | 44 | 1.73 | 1.95 | 76 |
| September 30 | do | 34 | 44 | 2.93 | 2.45 | 129 |

*Daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.35 | 2.22 | 2.35 | 2.28 | 3.7 | 4.15 | 3.35 | 2.33 | 1.4 | 1.9 | 1.33 | 2.25 |
| 2 | 2.38 | 2.2 | 2.4 | 2.4 | 4.25 | 4.8 | 3.3 | 2.05 | 1.23 | 1.77 | 1.43 | 2.25 |
| 3 | 2.3 | 2.2 | 2.55 | 2.4 | 3.6 | 5.0 | 2.4 | 2.1 | 1.57 | 1.5 | 1.33 | 2.45 |
| 4 | 2.28 | 2.2 | 2.6 | 2.32 | 3.2 | 5.8 | 2.2 | 2.0 | 1.73 | 1.45 | 1.45 | 2.35 |
| 5 | 2.3 | 2.2 | 2.45 | 2.15 | 3.08 | 5.65 | 2.15 | 1.95 | 1.47 | 1.45 | 1.45 | 2.35 |
| 6 | 2.32 | 2.2 | 2.48 | 2.35 | 2.7 | 5.15 | 2.3 | 2.0 | 1.33 | 1.35 | 1.43 | 2.25 |
| 7 | 2.25 | 2.2 | 2.4 | 2.35 | 2.55 | 5.55 | 2.35 | 2.05 | 1.5 | 1.35 | 1.4 | 2.3 |
| 8 | 2.38 | 2.2 | 2.32 | 2.5 | 2.45 | 5.5 | 2.4 | 1.93 | 1.4 | 1.4 | 1.45 | 2.15 |
| 9 | 2.32 | 2.2 | 2.3 | 2.55 | 2.5 | 5.25 | 2.25 | 2.0 | 1.47 | 1.2 | 1.4 | 2.15 |
| 10 | 2.2 | 2.2 | 2.3 | 2.5 | 2.55 | 5.05 | 2.15 | 2.03 | 1.5 | 1.2 | 1.4 | 2.05 |
| 11 | ...... | 2.2 | 2.3 | 2.45 | 2.75 | 5.25 | 2.15 | 1.93 | 1.4 | 1.2 | 1.4 | 2.25 |
| 12 | ...... | 2.2 | 2.3 | 2.4 | 3.3 | 5.0 | 2.15 | 1.93 | 1.45 | 1.2 | 1.3 | 2.3 |
| 13 | ...... | 2.2 | 2.3 | 2.4 | 3.35 | 4.85 | 2.25 | 2.25 | 1.57 | 1.2 | 1.2 | 2.35 |
| 14 | ...... | ...... | 2.3 | 2.4 | 3.62 | 4.7 | 2.1 | 2.0 | 1.5 | 1.23 | 1.35 | 2.3 |
| 15 | ...... | ...... | 2.3 | 2.25 | 3.62 | 4.53 | 2.15 | 1.95 | 1.5 | 1.23 | 1.5 | 2.25 |
| 16 | ...... | ...... | 2.2 | 2.02 | 3.65 | 4.6 | 2.25 | 1.93 | 1.5 | 1.2 | 1.35 | 2.1 |
| 17 | ...... | ...... | 2.2 | 2.02 | 3.5 | 4.45 | 2.15 | 1.9 | 1.47 | 1.2 | 1.45 | 2.2 |
| 18 | ...... | ...... | 2.25 | 2.02 | 3.6 | 4.3 | 2.0 | 1.73 | 1.35 | 1.17 | 1.35 | 2.3 |
| 19 | 2.25 | ...... | 2.21 | 2.0 | 3.6 | 4.3 | 1.95 | 1.63 | 1.45 | 1.23 | 1.45 | 2.35 |
| 20 | 2.3 | 2.2 | 2.2 | 2.0 | 3.75 | 3.45 | 2.4 | 1.57 | 1.4 | 1.17 | 1.35 | 2.2 |
| 21 | 2.3 | 2.2 | 2.2 | 2.0 | 3.85 | 3.35 | 2.0 | 1.55 | 1.25 | 1.17 | 1.25 | 2.3 |
| 22 | 2.35 | 2.22 | 2.2 | 2.0 | 3.92 | 3.45 | 2.2 | 1.45 | 1.4 | 1.23 | 1.3 | 2.35 |
| 23 | 2.3 | 2.2 | 2.35 | 2.02 | 4.48 | 3.4 | 2.05 | 1.43 | 1.4 | 1.35 | 1.55 | 2.25 |
| 24 | 2.28 | 2.25 | 2.25 | 2.25 | 4.5 | 3.5 | 2.05 | 1.45 | 1.43 | 1.35 | 1.5 | 2.3 |
| 25 | 2.3 | 2.25 | 2.45 | 2.35 | 4.55 | 3.45 | 1.97 | 1.35 | 1.53 | 1.4 | 1.65 | 2.2 |
| 26 | 2.2 | 2.22 | 2.35 | 2.5 | 4.45 | 3.55 | 1.95 | 1.4 | 1.47 | 1.45 | 1.65 | 2.1 |
| 27 | 2.2 | 2.22 | 2.35 | 2.85 | 4.25 | 3.7 | 2.0 | 1.4 | 1.43 | 1.35 | 1.75 | 2.05 |
| 28 | 2.2 | 2.3 | 2.32 | 3.85 | 4.1 | 3.4 | 2.15 | 1.85 | 1.33 | 1.5 | 1.7 | 2.05 |
| 29 | 2.22 | ...... | 2.25 | 3.88 | 4.0 | 3.25 | 2.75 | 1.53 | 1.55 | 1.5 | 1.75 | 2.05 |
| 30 | 2.22 | ...... | 2.22 | 3.7 | 4.05 | 3.2 | 2.83 | 1.37 | 1.87 | 1.45 | 2.05 | 2.1 |
| 31 | 2.2 | ...... | 2.3 | ...... | 3.9 | ...... | 2.8 | 1.37 | ...... | 1.37 | ...... | 2.15 |

NOTE.—River frozen January 11–17, February 14–19.

*Station rating table for Uncompahgre River at Montrose, Colo., from January 1 to June 3, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 57 | 2.80 | 184 | 3.60 | 412 | 4.40 | 717 |
| 2.10 | 69 | 2.90 | 207 | 3.70 | 446 | 4.50 | 765 |
| 2.20 | 82 | 3.00 | 231 | 3.80 | 481 | 4.60 | 817 |
| 2.30 | 96 | 3.10 | 257 | 3.90 | 516 | 4.70 | 874 |
| 2.40 | 111 | 3.20 | 285 | 4.00 | 552 | 4.80 | 936 |
| 2.50 | 127 | 3.30 | 315 | 4.10 | 590 | 4.90 | 1,004 |
| 2.60 | 144 | 3.40 | 346 | 4.20 | 630 | 5.00 | 1,080 |
| 2.70 | 163 | 3.50 | 379 | 4.30 | 672 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is fairly well defined between gage heights 2 feet and 4.3 feet.

*Station rating table for Uncompahgre River at Montrose, Colo., from June 4 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 6 | 2.00 | 86 | 3.00 | 288 | 4.00 | 595 |
| 1.10 | 10 | 2.10 | 100 | 3.10 | 315 | 4.20 | 671 |
| 1.20 | 14 | 2.20 | 116 | 3.20 | 343 | 4.40 | 755 |
| 1.30 | 19 | 2.30 | 133 | 3.30 | 371 | 4.60 | 850 |
| 1.40 | 25 | 2.40 | 151 | 3.40 | 400 | 4.80 | 970 |
| 1.50 | 32 | 2.50 | 170 | 3.50 | 430 | 5.00 | 1,125 |
| 1.60 | 40 | 2.60 | 191 | 3.60 | 461 | 5.20 | 1,300 |
| 1.70 | 50 | 2.70 | 213 | 3.70 | 493 | 5.40 | 1,500 |
| 1.80 | 61 | 2.80 | 237 | 3.80 | 526 | 5.60 | 1,725 |
| 1.90 | 73 | 2.90 | 262 | 3.90 | 560 | 5.80 | 1,970 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 2 feet and 4 feet. Below 1.9 the table is very uncertain. The table has been extended beyond these limits.

*Estimated monthly discharge of Uncompahgre River at Montrose, Colo., for 1905.*

[Drainage area, 565 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January (23 days) | 108 | 82 | 93.1 | 4,247 | .165 | .141 |
| February (22 days) | 96 | 82 | 83.8 | 3,657 | .148 | .121 |
| March | 144 | 82 | 99.7 | 6,130 | .176 | .203 |
| April | 446 | 57 | 115 | 6,843 | .204 | .228 |
| May | 791 | 119 | 433 | 26,620 | .766 | .883 |
| June | 1,970 | 343 | 873 | 51,950 | 1.55 | 1.73 |
| July | 386 | 80 | 140 | 8,608 | .248 | .286 |
| August | 138 | 22 | 64.4 | 3,960 | .114 | .131 |
| September | 69 | 16 | 30.1 | 1,791 | .053 | .059 |
| October | 73 | 13 | 23.3 | 1,433 | .041 | .047 |
| November | 93 | 14 | 31.2 | 1,856 | .055 | .061 |
| December | 160 | 93 | 121 | 7,440 | .214 | .247 |
| The period | | | | 124,500 | | |

## UNCOMPAHGRE RIVER AT DELTA, COLO.

This station was established April 29, 1903. It was originally located at a highway bridge one-fourth mile above the Denver and Rio Grande Railroad bridge, but on November 17, 1903, the station was removed to the Denver and Rio Grande Railroad bridge, one-fourth mile northwest of the Denver and Rio Grande Railroad station, in order that the measured discharge of the river might include the mill-ditch waste. Excluding the discharge of seasonal high water in May or June and an occasional rise from local storms, the water passing this station is entirely seepage water from irrigation above.

The channel at the gage rod and the bridge below is a long gentle curve. The right bank is of earth, is high and clean, and is not subject to overflow. The left bank is also of earth and is clean; but it is low and may overflow during extreme high water. The bed of the stream is composed of earth and fragments of rock and is fairly permanent. There is but one channel at all stages. The current is sluggish at low and swift at high water. Gage heights range from 0.6 foot to 4 feet.

Discharge measurements were originally made from the highway bridge, to which the first gage was attached, or by wading near the gage. From November 17, 1903, to May 2, 1904, measurements were made from the Denver and Rio Grande Railroad bridge. After the latter date measurements were made from the single-span road bridge 100 feet below the new gage. The initial point for soundings is the face of the left abutment at the downstream side of the road bridge and is marked by a brass-headed nail in the hand rail. At low-water measurements are made by wading near the bridge.

Gage readings at this station are made by Michael O'Rourke. The first gage at the railroad bridge was a vertical rod nailed to a 12-inch pile on the downstream side of the bridge. It read from 1 foot to 6 feet. Readings were taken from this gage until April 21, 1904, when a new gage was installed on the right bank 45 feet east of the center of the Denver and Rio Grande Railroad track at the south approach to the bridge. There is no definite and constant relation between the new and old rods as the cross sections are not identical. The new gage is an inclined rod, graduated up to 6 feet. The bottom of the rod rests on the river bottom and is held in place by six 2- by 4-inch timbers driven firmly into the bank. The bench mark for the vertical gage was a cross on the top of the lower chord of the bridge over the gage rod; its elevation was 8.75 feet above the zero of the gage. The bench mark for the inclined gage is a point marked with black paint and the letters "B. M.," on the surface of the northeast corner of the stone abutment where the south end of the steel bridge rests, on the downstream side; elevation, 7.36 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 67; 133, pp 177-178.
Discharge: 66, p 98; 100, p 68; 133, p 178.
Discharge, monthly: 100, p 69; 133, p 180.
Gage heights: 100, p 68; 133, p 179.
Rating tables: 100, p 69; 133, pp 179-180.

*Discharge measurements of Uncompahgre River at Delta, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 12 | R. I. Meeker | 58 | 64 | 1.78 | 1.45 | 114 |
| May 5 | Oro McDermith | 64 | 110 | 2.21 | 2.05 | 243 |
| May 19 | A. A. Weiland | 64 | 179 | 4.95 | 3.30 | 887 |
| May 31 | do | 64 | 145 | 3.23 | 2.42 | 469 |
| June 12 | do | 64 | 240 | 5.88 | 3.90 | 1,411 |
| June 26 | do | 64 | 122 | 2.93 | 2.22 | 358 |
| July 11 | do | 49 | 38 | .53 | .80 | 20 |
| July 31 | do | 47 | 40 | .62 | .90 | 25 |
| October 2 | R. I. Meeker | 50 | 44 | .82 | 1.00 | 36 |

*Daily gage height, in feet, of Uncompahgre River at Delta, Colo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 1.57 | 2.0 | 1.47 | 2.62 | 2.92 | 1.48 | 1.14 | 0.76 | 0.99 | 0.8 | 1.49 |
| 2 | 1.8 | 1.58 | 2.22 | 1.52 | 3.08 | 3.28 | 1.32 | .98 | .72 | .95 | .81 | 1.5 |
| 3 | 1.74 | 1.64 | 2.07 | 1.61 | 2.94 | 3.44 | 1.06 | .9 | .71 | .91 | .82 | 1.47 |
| 4 | 1.8 | 1.69 | 2.08 | 1.45 | 2.39 | 3.66 | .96 | .84 | .76 | .88 | .83 | 1.5 |
| 5 | 1.76 | 1.73 | 1.98 | 1.36 | 2.06 | 4.2 | .92 | .8 | .87 | .86 | .84 | 1.53 |
| 6 | 1.8 | 1.66 | 1.84 | 1.23 | 1.78 | 4.2 | .88 | .82 | .86 | .78 | .84 | 1.5 |
| 7 | 1.84 | 1.62 | 1.79 | 1.2 | 1.72 | 3.79 | .78 | .88 | .87 | .82 | .86 | 1.49 |
| 8 | ....... | 1.64 | 1.76 | 1.4 | 1.87 | 4.0 | .81 | .82 | .8 | .84 | .86 | 1.6 |
| 9 | ....... | 1.54 | 1.67 | 1.42 | 2.0 | 4.23 | .81 | .81 | .81 | .84 | .84 | 1.63 |
| 10 | ....... | 1.5 | 1.59 | 1.49 | 1.91 | 4.38 | .8 | .78 | .84 | .84 | .83 | 1.57 |
| 11 | ....... | 1.58 | 1.53 | 1.46 | 1.67 | 3.97 | .8 | .78 | .84 | .82 | .82 | 1.54 |
| 12 | ....... | 1.5 | 1.49 | 1.44 | 1.5 | 3.88 | .77 | .81 | .79 | .83 | .84 | 1.48 |
| 13 | ....... | 1.39 | 1.47 | 1.22 | 1.43 | 3.7 | .78 | .8 | .78 | .82 | .86 | 1.53 |
| 14 | ....... | 1.35 | 1.47 | 1.13 | 1.38 | 3.57 | .76 | .81 | .76 | .82 | .85 | 1.63 |
| 15 | ....... | ....... | 1.49 | 1.13 | 1.32 | 3.54 | .76 | .79 | .76 | .82 | .84 | 1.68 |
| 16 | ....... | ....... | 1.5 | 1.03 | 1.55 | 3.45 | .74 | .72 | .76 | .82 | .85 | 1.62 |
| 17 | ....... | ....... | 1.53 | 1.04 | 2.52 | 3.15 | .73 | .69 | .7 | .8 | .91 | 1.63 |
| 18 | ....... | ....... | 1.58 | 0.95 | 2.94 | 3.03 | .71 | .69 | .77 | .78 | .9 | 1.69 |
| 19 | ....... | ....... | 1.5 | .98 | 3.34 | 3.0 | .7 | .71 | .78 | .79 | .89 | 1.69 |
| 20 | ....... | ....... | 1.5 | 1.06 | 3.54 | 2.8 | .68 | .72 | .79 | .83 | .9 | 1.64 |
| 21 | ....... | ....... | 1.56 | .96 | 3.5 | 2.68 | .68 | .72 | .82 | .82 | .91 | 1.7 |
| 22 | 1.56 | 1.68 | 1.59 | .87 | 3.54 | 2.43 | .7 | .73 | .82 | .81 | .9 | 1.77 |
| 23 | 1.6 | 1.66 | 1.59 | .88 | 3.68 | 2.2 | .74 | .73 | .83 | .82 | .88 | 1.88 |
| 24 | 1.62 | 1.63 | 1.47 | .87 | 3.76 | 2.22 | .74 | .73 | .84 | .83 | .88 | 1.94 |
| 25 | 1.61 | 1.66 | 1.45 | .82 | 3.58 | 2.14 | .69 | .72 | .78 | .8 | .93 | ....... |
| 26 | 1.62 | 1.69 | 1.46 | .78 | 3.53 | 2.12 | .66 | .78 | .92 | .82 | 1.0 | ....... |
| 27 | 1.6 | 1.75 | 1.54 | .76 | 3.41 | 2.08 | .67 | .77 | .83 | .82 | 1.13 | ....... |
| 28 | 1.56 | 1.85 | 1.58 | 1.65 | 3.26 | 2.04 | .7 | .74 | .84 | .84 | 1.25 | ....... |
| 29 | 1.5 | ....... | 1.48 | 2.23 | 2.96 | 1.83 | .68 | .77 | .84 | .79 | 1.29 | ....... |
| 30 | 1.56 | ....... | 1.47 | 2.42 | 2.59 | 1.7 | .7 | .77 | .85 | .78 | 1.26 | ....... |
| 31 | 1.56 | ....... | 1.43 | ....... | 2.56 | ....... | 1.21 | .76 | ....... | .8 | ....... | ....... |

NOTE.—River frozen January 8-21 and February 15-21.

*Station rating table for Uncompahgre River at Delta, Colo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 3 | 1.60 | 150 | 2.60 | 535 | 3.60 | 1,145 |
| .70 | 8 | 1.70 | 180 | 2.70 | 585 | 3.70 | 1,220 |
| .80 | 15 | 1.80 | 210 | 2.80 | 640 | 3.80 | 1,295 |
| .90 | 24 | 1.90 | 240 | 2.90 | 695 | 3.90 | 1,375 |
| 1.00 | 35 | 2.00 | 275 | 3.00 | 750 | 4.00 | 1,455 |
| 1.10 | 50 | 2.10 | 315 | 3.10 | 810 | 4.10 | 1,535 |
| 1.20 | 65 | 2.20 | 355 | 3.20 | 870 | 4.20 | 1,620 |
| 1.30 | 85 | 2.30 | 395 | 3.30 | 935 | 4.30 | 1,710 |
| 1.40 | 105 | 2.40 | 440 | 3.40 | 1,005 | 4.40 | 1,800 |
| 1.50 | 125 | 2.50 | 485 | 3.50 | 1,075 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905, and is not well defined.

*Estimated monthly discharge of Uncompahgre River at Delta, Colo., for 1905.*

[Drainage area, 1,130 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 1-7; 22-31 | 222 | 125 | 167 | 5,631 | 0.148 | 0.094 |
| February 1-14; 22-28 | 225 | 95 | 157 | 6,539 | .139 | .109 |
| March | 363 | 111 | 161 | 9,900 | .142 | .164 |
| April | 449 | 6 | 88.1 | 5,242 | .078 | .087 |
| May | 1,265 | 89 | 597 | 36,710 | .528 | .609 |
| June | 1,782 | 180 | 894 | 53,200 | .791 | .882 |
| July | 121 | 6 | 21.0 | 1,291 | .019 | .022 |
| August | 56 | 8 | 15.3 | 941 | .014 | .016 |
| September | 26 | 8 | 15.8 | 940 | .014 | .016 |
| October | 34 | 14 | 18.1 | 1,113 | .016 | .018 |
| November | 83 | 15 | 27.9 | 1,660 | .025 | .028 |
| December | 254 | 119 | 156 | 7,426 | .138 | .123 |
| The period | .......... | .......... | .......... | 130,600 | .......... | .......... |

### MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Gunnison River basin in 1905:

*Miscellaneous discharge measurements made in Gunnison River drainage basin in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| August 10 | Lotis Creek | Just above mouth | 14 | 13 | 1.92 | 25 |
| August 22 | East River | 1 mile below Brush Creek | 40 | 34 | 1.88 | 64 |
| August 22 | Slate River | 1 mile below Crested Butte, Colo. | 60 | 34 | 1.12 | 38 |

## COLORADO RIVER DRAINAGE BASIN BETWEEN JUNCTION OF GRAND AND GREEN RIVERS AND YUMA.

### COLORADO RIVER.

#### DESCRIPTION OF RIVER.

From the junction of Grand and Green rivers the Colorado flows southwestward, passes across the northwestern corner of Arizona, then turns to the south and for the remainder of its course forms a part of the southeastern boundary of Nevada and California and the western boundary of Arizona. It empties into the Gulf of California about 60 miles below Yuma, Ariz. The canyons through which it flows are world famed and need not here be described.

The Colorado has been called the Nile of America, and like the Nile it is subject to an annual summer rise which comes at the time when it is most needed for irrigation. It is of interest to compare the Colorado with the Nile and Susquehanna rivers. The Nile being similar in type, the Susquehanna being contrasted and showing the difference in flow between arid and humid regions. In this comparison a normal year based upon records of the past ten years for the Colorado and Susquehanna rivers and such data as could be found in regard to the Nile has been used. The Colorado has been taken as the standard of comparison

The Nile has 5.7 times the drainage area and the Susquehanna about one-eighth the area. The rainfall in the Nile basin is 3.8 times greater; that in the Susquehanna basin is 4.5 times greater. The run-off per square mile from the Nile basin is 1.9 times greater; that from the Susquehanna basin is 37 times greater. The ratio of run-off to rainfall in the Nile basin is 2 times smaller; that of the Susquehanna basin is 8.2 times greater.

The discharge of the Nile is 10.8 times greater; that of the Susquehanna is 4.5 times greater.

The maximum flow of the Colorado is from 70,000 to 110,000 second-feet and occurs in May, June, or July; for the Nile it is about 353,000 second-feet and occurs about the first of September; for the Susquehanna it is from 200,000 to 400,000 second-feet and occurs during March, April, and May.

The minimum flow of the Colorado is from 2,500 to 3,000 second-feet and occurs during January and February; that of the Nile is about 14,500 second-feet and occurs about the end of May; for the Susquehanna it is from 2,500 to 5,000 second-feet and occurs in September and October.

The mean flow of the Colorado is about 10,700 second-feet; for the Nile it is about 115,800 second-feet; for the Susquehanna it is about 43,000 second-feet.

The water of the Colorado carries an immense amount of sediment, reaching as high as 2,000 parts of sediment to 100,000 parts of water. Prof. R. H. Forbes, in Bulletin No. 44, University of Arizona Agricultural Experiment Station, says:

> On the basis of the profile constructed from available data for the volume of flow of the Colorado, and of the year's silt determinations made in the laboratory, it is estimated conservatively that the river during 1900 brought down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles 1 foot deep, or to make about 164 square miles of recently settled, submerged mud 1 foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

A comparatively small amount of land is irrigated by the waters of the Colorado, owing to the fact that the stream and its tributaries are situated so far below the level of the irrigable lands as to render their diversion extremely difficult or impracticable. There are two pumping plants that lift water for irrigation at Yuma and several at other points on the river above Yuma. The Imperial canal diverts water from the river at a point about 10 miles by river below Yuma.

The principal tributaries of the Colorado below the Grand and Green are the San Juan, Little Colorado, Bill Williams Fork, and Gila rivers, which enter from the east, and the Virgin River, which enters from the west. With the exception of the Virgin and Bill Williams Fork rivers, these streams and their various tributaries are described in other parts of this report.

## COLORADO RIVER AT HARDYVILLE, ARIZ.

This station was established May 11, 1905. It is maintained in cooperation with the State of California, and is located one-fourth mile above the deserted town of Hardyville and 7 miles above Fort Mohave, Ariz.

The right bank is composed of cemented gravel, is high, and is not subject to overflow. The left bank is made up of alluvial material, easily eroded, is low and wooded, and is liable to overflow at flood stages. The bed is composed of cemented gravel and changes gradually as the river falls from flood stage to low water, a bar forming in that portion of the section nearest the right bank and altering the section materially. There is but one channel at all stages. The flow ranges from 3,000 to 100,000 second-feet, with velocities of from 2 to 8 feet per second and a variation of probably 12 feet in gage heights.

Discharge measurements are made from a car and cable located 250 feet above the pumping plant of the Rattan mill. The initial point for soundings is the end of the turn-buckle farthest from the river on the Nevada side.

The gage, which was read once each day during 1905 by Marion Herrick, is located 275 feet below the cable on the left bank. The gage is in two sections: The lower section is an inclined rod fastened to posts buried in the bank; the upper section is a timber set vertically in the bank. The bench mark is the top of a 3-inch iron pipe buried in the gravel bank 100 feet from the river and 40 feet below the gage rod. Its elevation is 20.54 feet above the zero of the gage and 507.18 feet above sea level.

*Discharge measurements of Colorado River at Hardyville, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| May 17 | O. W. Peterson | 6.65 | 33,140 | August 13 | C. W. Jenkins | 4.20 | 12,270 |
| May 20 | do | 6.95 | 33,910 | August 27 | do | 4.00 | 11,650 |
| May 27 | C. W. Jenkins | 11.20 | 69,010 | September 2 | do | 3.20 | 5,934 |
| June 4 | do | 10.50 | 64,750 | September 17 | do | 3.40 | 7,523 |
| June 10 | do | 14.50 | 107,700 | October 1 | do | 3.00 | 4,657 |
| June 18 | do | 12.80 | 81,030 | October 15 | do | 3.90 | 6,579 |
| June 25 | do | 10.15 | 52,860 | October 29 | do | 3.60 | 6,574 |
| July 9 | do | 6.70 | 30,650 | November 4 | Jenkins and Lee | 3.48 | 5,949 |
| July 16 | do | 5.70 | 22,400 | November 12 | C. W. Jenkins | 3.85 | 6,504 |
| July 23 | do | 5.10 | 17,620 | November 19 | do | 3.70 | 5,979 |
| July 30 | do | 4.60 | 14,590 | November 25 | do | 3.60 | 5,757 |
| August 6 | do | 5.00 | 17,040 | December 3 | do | 6.00 | 17,850 |

*Daily gage height, in feet, of Colorado River at Hardyville, Ariz., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 11.8 | 8.55 | 4.5 | 3.4 | 3.75 | 3.45 | 7.4 |
| 2 | | 11.5 | 8.4 | 4.5 | 3.4 | 4.05 | 3.45 | 7.1 |
| 3 | | 11.1 | 8.3 | 4.65 | 3.2 | 4.7 | 3.5 | 6.05 |
| 4 | | 10.7 | 8.0 | 4.8 | 3.2 | 4.35 | 3.45 | 5.35 |
| 5 | | 10.8 | 7.9 | 5.2 | 3.45 | 5.1 | 3.5 | 4.8 |
| 6 | | 11.85 | 7.55 | 5.0 | 3.55 | 4.8 | 3.5 | 4.5 |
| 7 | | 12.5 | 7.3 | 4.7 | 3.5 | 4.8 | 3.6 | 4.3 |
| 8 | | 13.1 | 7.0 | 4.7 | 3.6 | 4.7 | 4.0 | 4.2 |
| 9 | | 13.7 | 6.7 | 4.85 | 3.5 | 4.7 | 3.85 | 4.1 |
| 10 | | 14.4 | 6.7 | 4.6 | 3.6 | 4.45 | 3.85 | 3.9 |
| 11 | 6.85 | 14.3 | 6.5 | 4.5 | 4.0 | 4.25 | 3.75 | 3.75 |
| 12 | 6.9 | 14.0 | 6.15 | 4.3 | 3.7 | 4.1 | 3.85 | 3.75 |
| 13 | 6.95 | 14.3 | 6.0 | 4.25 | 3.5 | 4.0 | 3.8 | 3.8 |
| 14 | 7.15 | 14.45 | 5.85 | 4.15 | 3.5 | 3.95 | 3.65 | 3.8 |
| 15 | 7.15 | 14.5 | 5.2 | 4.0 | 3.45 | 3.85 | 3.85 | 3.7 |
| 16 | 6.95 | 13.8 | 5.85 | 4.0 | 3.45 | 3.8 | 3.75 | 3.7 |
| 17 | 6.7 | 13.3 | 5.5 | 3.9 | 3.4 | 3.7 | 3.7 | 3.7 |
| 18 | 6.8 | 12.8 | 5.3 | 3.8 | 3.3 | 3.7 | 3.7 | 3.7 |
| 19 | 6.95 | 12.5 | 5.25 | 3.8 | 3.2 | 3.7 | 3.7 | 3.6 |
| 20 | 7.0 | 12.2 | 5.2 | 3.8 | 3.2 | 3.6 | 3.7 | 3.6 |
| 21 | 7.35 | 11.85 | 5.1 | 3.75 | 3.05 | 3.55 | 3.6 | 3.65 |
| 22 | 8.1 | 11.35 | 5.1 | 3.75 | 3.05 | 3.5 | 3.6 | 3.7 |
| 23 | 8.8 | 10.8 | 5.1 | 3.6 | 3.0 | 3.5 | 3.6 | 3.8 |
| 24 | 9.5 | 10.5 | 4.95 | 3.6 | 3.05 | 3.5 | 3.7 | 3.8 |
| 25 | 9.9 | 10.15 | 4.85 | 3.6 | 2.95 | 3.45 | 3.6 | 3.8 |
| 26 | 10.6 | 10.0 | 4.7 | 4.75 | 2.95 | 3.5 | 5.4 | 3.95 |
| 27 | 11.1 | 9.5 | 4.7 | 3.7 | 2.95 | 3.45 | 5.4 | 3.9 |
| 28 | 11.5 | 9.1 | 4.7 | 3.4 | 2.95 | 3.5 | 5.1 | 3.9 |
| 29 | 12.7 | 9.2 | 4.7 | 3.3 | 3.95 | 3.55 | 5.0 | 3.9 |
| 30 | 12.4 | 9.6 | 4.65 | 3.4 | 3.95 | 3.5 | 5.1 | 3.8 |
| 31 | 12.1 | | 4.6 | 3.4 | | 3.5 | | 3.8 |

*Daily discharge, in second-feet, of Colorado River at Hardyville, Ariz., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 73,460 | 45,260 | 14,080 | 7,160 | 9,290 | 5,650 | 29,500 |
| 2 | ........ | 70,700 | 44,020 | 14,080 | 7,160 | 11,600 | 5,700 | 26,500 |
| 3 | ........ | 67,090 | 43,200 | 15,090 | 5,970 | 15,900 | 6,000 | 18,200 |
| 4 | ........ | 63,550 | 40,750 | 16,110 | 5,970 | 13,100 | 5,750 | 14,300 |
| 5 | ........ | 64,430 | 39,940 | 18,950 | 7,460 | 18,200 | 5,800 | 11,500 |
| 6 | ........ | 73,920 | 37,120 | 17,500 | 8,065 | 15,600 | 5,500 | 10,400 |
| 7 | ........ | 80,000 | 35,120 | 15,430 | 7,760 | 15,300 | 6,000 | 10,200 |
| 8 | ........ | 85,780 | 32,750 | 15,430 | 8,370 | 14,300 | 8,500 | 9,500 |
| 9 | ........ | 91,700 | 30,410 | 16,460 | 7,760 | 14,000 | 7,200 | 8,800 |
| 10 | ........ | 98,780 | 30,410 | 14,750 | 8,370 | 12,000 | 7,000 | 7,400 |
| 11 | 31,580 | 97,760 | 28,850 | 14,080 | 10,850 | 10,300 | 6,000 | 6,300 |
| 12 | 31,970 | 94,700 | 26,160 | 12,770 | 8,980 | 8,900 | 6,500 | 6,300 |
| 13 | 32,360 | 97,760 | 25,000 | 12,440 | 7,760 | 7,900 | 6,200 | 6,700 |
| 14 | 33,940 | 99,290 | 23,840 | 11,800 | 7,760 | 7,200 | 5,200 | 6,700 |
| 15 | 33,940 | 99,800 | 18,950 | 10,850 | 7,460 | 6,200 | 6,700 | 6,000 |
| 16 | 32,360 | 92,700 | 23,840 | 10,850 | 7,460 | 6,000 | 6,100 | 6,000 |
| 17 | 30,410 | 87,740 | 21,180 | 10,200 | 7,160 | 5,300 | 5,800 | 6,000 |
| 18 | 31,190 | 82,880 | 19,690 | 9,600 | 6,560 | 5,600 | 5,900 | 6,000 |
| 19 | 32,360 | 80,000 | 19,320 | 9,600 | 5,970 | 5,600 | 5,989 | 5,300 |
| 20 | 32,750 | 77,180 | 18,950 | 9,600 | 5,970 | 5,200 | 6,000 | 5,300 |
| 21 | 35,520 | 73,920 | 18,220 | 9,290 | 5,090 | 4,850 | 5,400 | 5,600 |
| 22 | 41,560 | 69,340 | 18,220 | 9,290 | 5,090 | 4,800 | 5,500 | 6,000 |
| 23 | 47,330 | 64,430 | 18,220 | 8,370 | 4,800 | 4,800 | 5,600 | 6,700 |
| 24 | 53,230 | 61,810 | 17,150 | 8,370 | 5,090 | 5,050 | 6,350 | 6,700 |
| 25 | 56,640 | 58,790 | 16,460 | 8,370 | 4,515 | 4,700 | 5,760 | 6,700 |
| 26 | 62,680 | 57,500 | 15,430 | 15,770 | 4,515 | 5,400 | 17,800 | 7,800 |
| 27 | 67,090 | 53,230 | 15,430 | 8,980 | 4,515 | 5,050 | 17,300 | 7,400 |
| 28 | 70,700 | 49,840 | 15,430 | 7,160 | 4,515 | 5,700 | 14,500 | 7,400 |
| 29 | 81,920 | 50,680 | 15,430 | 6,560 | 10,540 | 6,050 | 13,200 | 7,400 |
| 30 | 79,060 | 54,080 | 15,090 | 7,160 | 10,540 | 5,900 | 13,300 | 6,700 |
| 31 | 76,240 | ....... | 14,750 | 7,160 | ........ | 5,900 | ........ | 6,700 |

**Note.**—Rating table used May 11 to October 1. For the remainder of the period indirect method was used.

*Estimated monthly discharge of Colorado River at Hardyville, Ariz., for 1905.*

[Drainage area, 138,600 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May 11 to 31 | 81,920 | 30,410 | 47,370 | 1,973,000 | .342 | .267 |
| June | 99,800 | 49,840 | 75,760 | 4,508,000 | .547 | .610 |
| July | 45,260 | 14,750 | 25,310 | 1,556,000 | .183 | .211 |
| August | 18,950 | 6,560 | 11,810 | 726,200 | .085 | .098 |
| September | 10,850 | 4,515 | 6,972 | 414,900 | .050 | .056 |
| October | 18,200 | 4,700 | 8,571 | 527,000 | .062 | .071 |
| November | 17,800 | 5,200 | 7,606 | 452,600 | .055 | .061 |
| December | 29,500 | 5,300 | 9,097 | 559,400 | .066 | .076 |
| The period | ........ | ........ | ........ | 10,720,000 | ........ | ........ |

## SAN JUAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

San Juan River rises among the snow masses that crown the high peaks of the San Juan Mountains in southwestern Colorado, flows southwestward into New Mexico, then swings to the west and northwest, passing from San Juan County, N. Mex., across the extreme southwestern corner of Colorado into San Juan County, Utah, in the southwestern part of which it unites with the Colorado.

For the first 75 miles of its course the San Juan is a typical mountain stream, but at Canyon Largo, N. Mex., where it turns westward, its character changes, and it occupies a broad-winding, sandy channel in an arid valley, bordered on each side by terraced mesas. Below the mouth of Mancos River the valley narrows and the river bottom is bounded by abrupt bluffs, broken and cut by dry water channels, and merging farther on into the walls of a deep, narrow, box canyon in which the river flows to its end.

The drainage area includes portions of four States and Territories. Its topography ranges in type from mountainous at the headwaters in Colorado to the types exemplified in the valleys, plateaus, and eroded mesas of Utah, New Mexico, and Arizona. Large areas of eruptive rocks occur in the highest portions of the basin, but the predominating formations are of sedimentary origin. The headwater streams are protected by fine forests of spruce and yellow pine and, at lower elevations, large areas of aspen. The lower basin is practically barren except for an extensive growth of sagebrush, scattered cedars, piñons, and range grasses.

The principal tributaries of the San Juan are Navajo, Piedra, Pine, Florida, Animas, and La Plata rivers, the Animas being the most important.

Animas River has its source in the region above Silverton, draining portions of the Needle and La Plata mountains, the former being the most rugged of the Rocky Mountain ranges. The river flows southward to the Colorado-New Mexico line and thence southwestward to the point where it joins the San Juan at Farmington, N. Mex. The upper portion of the basin, above Durango, is very mountainous and furnishes the greater part of the run-off. This region is generally well timbered with pine, spruce, and aspen, but large areas consist of naked granite peaks. Immediately above and below Durango the valley broadens and is bordered by mesas and bluffs cut by narrow canyons and covered with sagebrush and scattered pines and piñons; along the stream channels cottonwoods predominate. The rocks of this region are chiefly of sedimentary origin. The soils of the lower valleys consist of sandy loam and are very fertile.

La Plata River rises in the granite masses known as La Plata Mountains, about 25 miles northwest of Durango, Colo., and flows southward to its point of junction with the San Juan. Its drainage basin is a narrow strip parallel to and adjoining the Animas basin. The upper portion of the basin is a well-watered and forest-clad mountain region which merges southward into an arid mesa, plateau, and canyon country. La Plata Valley proper is a narrow, shallow depression from Hesperus down, bounded on both sides by high, broken table-lands and deeply eroded mountains. The lower mountain slopes are covered with piñon, scrub oak, and cedar; the lower valleys support heavy growths of sagebrush and chico; the upper mountain slopes were at one time heavily timbered with spruce and yellow and white pine, but these forests have been largely removed by lumbermen.

The other tributaries of the San Juan need not here be described. Those mentioned are perennial streams but much of their water is diverted for irrigation and never reaches the main river. In addition to the perennial streams are many intermittent creeks throughout New Mexico which contribute large volumes of water during heavy storms.

Much land is now under cultivation along the valleys of the San Juan, Animas, Pine, Florida, and La Plata rivers and the smaller tributaries in Colorado. Numerous small lakes high up in the mountains tend to equalize the flow of some of the tributaries, and many large and small storage-reservoir sites are available which will in time be developed.

One large power plant has been constructed in this basin and others are contemplated. The largest deposits of lignite and bituminous and coking coal to be found in the West are in this drainage area.

## SAN JUAN RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904. It is located near the Methodist Indian school about 3 miles south of Farmington, N. Mex., and about 2 miles below the mouth of Animas River.

The channel is straight for about 900 feet above and below the station. The right bank is a high sandstone cliff and can not overflow. The left bank at low water is a gravel bar extending out to 325 feet from the initial point for soundings, when it rises to a height of 6 feet; it probably never overflows beyond this point. The bed of the stream is composed of cobblestones, shale, and a few large, scattered bowlders. It is clean and permanent except on the left side where sand rests on the shale. There is but one channel at all stages. The current is swift at high and medium at low water. Gage heights range from 3 to 12 feet.

Discharge measurements were made from the suspension footbridge, which was carried away by the high water of 1905. Since then discharge measurements have been impracticable as there is no other bridge on the river.

The gage, which was read during 1905 by Elmer King, is a standard chain gage and is attached to a framework extending from the top of a sandstone cliff, about 15 feet above low water, on the right bank of the river, about 300 yards above the bridge. The gage scale is placed horizontally on the top of the cliff and is graduated from zero to 20 feet. The length of the wire from the end of the weight to the marker, which is a knot tied in the wire near the ring, is 20.79 feet. On May 23, 1905, a high-water gage, consisting of an inclined staff graduated to read from 8.6 to 16.4 feet, was set in the right bank about 150 feet below the wire gage. The bench mark is a cross, painted black and marked "U. S. G. S. B. M.," on the top of the sandstone cliff about 50 feet east of the gage; elevation above the datum of the wire gage, 12.79 feet. The top of the gage rod (above the brace) is 0.82 foot above the bench mark. The elevation of the bench mark above the datum of the new gage is 12.94 feet, and hence the datum of the new gage is 0.15 foot above the datum of the old gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 180–183.

A measurement made by M. C. Hinderlider May 23, 1905, gave the following results: Width, 302 feet; area, 1,764 square miles; mean velocity, 9.73 feet per second; gage height, 10.55 feet; discharge, 17,170 second-feet.

*Daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.22 | 3.3 | 4.15 | 4.18 | 7.0 | 10.05 | 7.4 | 5.55 | 4.25 | 5.95 | 4.22 | 4.18 |
| 2 | 3.35 | 3.4 | 4.25 | 4.32 | 7.5 | 10.7 | 6.15 | 5.3 | 4.28 | 5.5 | 4.25 | 4.15 |
| 3 | 3.3 | 3.35 | 4.75 | 4.4 | 7.25 | 12.4 | 6.05 | 5.0 | 4.22 | 5.12 | 4.2 | 4.18 |
| 4 | 3.25 | 3.35 | 5.1 | 4.15 | 6.9 | 12.25 | 6.0 | 4.95 | 4.32 | 4.85 | 4.22 | 4.25 |
| 5 | 3.3 | 3.75 | 5.0 | 4.15 | 6.75 | 12.35 | 6.0 | 4.95 | 4.68 | 4.75 | 4.2 | 4.28 |
| 6 | 3.15 | 3.68 | 4.95 | 4.35 | 6.6 | 13.1 | 5.85 | 4.9 | 4.65 | 4.55 | 4.22 | 4.28 |
| 7 | 3.2 | 3.55 | 5.4 | 4.5 | 6.4 | 11.65 | 5.6 | 4.8 | 4.62 | 4.52 | 4.25 | 4.3 |
| 8 | 3.3 | 3.58 | 5.05 | 4.88 | 6.35 | 11.8 | 5.85 | 4.7 | 4.65 | 4.48 | 4.32 | 4.22 |
| 9 | 3.22 | 3.5 | 4.6 | 4.75 | 6.2 | 12.0 | 5.8 | 4.65 | 4.58 | 4.48 | 4.22 | 4.18 |
| 10 | 3.3 | 3.55 | 4.45 | 5.0 | 6.4 | 11.9 | 5.65 | 4.55 | 4.55 | 4.55 | 4.2 | 4.2 |
| 11 | 3.22 | 3.45 | 4.15 | 6.95 | 6.3 | 12.0 | 5.6 | 4.7 | 4.55 | 4.52 | 4.15 | 4.15 |
| 12 | 3.1 | 3.85 | 4.25 | 7.1 | 6.05 | 12.05 | 5.45 | 4.7 | 4.55 | 4.45 | 4.2 | 4.2 |
| 13 | 3.1 | 3.2 | 4.15 | 6.35 | 5.95 | 11.9 | 5.4 | 4.8 | 4.5 | 4.48 | 4.15 | 4.2 |

*Daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1905*—Cont'd.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 3.12 | 3.35 | 4.15 | 6.15 | 6.05 | 11.6 | 5.25 | 4.7 | 4.5 | 4.48 | 4.18 | 4.18 |
| 15 | 2.75 | 3.35 | 4.55 | 6.22 | 6.1 | 11.4 | 5.15 | 4.55 | 4.45 | 4.45 | 4.2 | 4.15 |
| 16 | 3.25 | 3.25 | 4.55 | 6.35 | 6.7 | 11.4 | 5.2 | 4.45 | 4.45 | 4.42 | 4.2 | 4.2 |
| 17 | 3.3 | 3.3 | 4.6 | 6.0 | 7.65 | 11.75 | 5.15 | 4.4 | 4.42 | 4.4 | 4.22 | 4.2 |
| 18 | 3.35 | 3.35 | 4.8 | 5.9 | 8.0 | 10.6 | 5.1 | 4.35 | 4.38 | 4.38 | 4.2 | 4.12 |
| 19 | 3.35 | 3.4 | 4.7 | 5.95 | 8.35 | 10.7 | 5.15 | 4.25 | 4.32 | 4.38 | 4.2 | 4.15 |
| 20 | 3.1 | 3.4 | 4.7 | 5.95 | 8.75 | 10.75 | 5.1 | 4.12 | 4.32 | 4.3 | 4.2 | 4.2 |
| 21 | 3.15 | 3.4 | 4.65 | 5.8 | 8.8 | 9.9 | 5.05 | 4.08 | 4.35 | 4.28 | 4.15 | 4.2 |
| 22 | 3.38 | 3.8 | 4.48 | 5.95 | 8.1 | 10.05 | 5.2 | 4.05 | 4.3 | 4.3 | 4.6 | 4.1 |
| 23 | 3.2 | 5.02 | 4.0 | 6.75 | 11.2 | 10.0 | 5.1 | 3.95 | 4.28 | 4.28 | 4.4 | 3.95 |
| 24 | 3.2 | 4.95 | 3.9 | 7.0 | 11.05 | 9.85 | 5.05 | 4.65 | 4.3 | 4.28 | 4.2 | 4.0 |
| 25 | 3.25 | 4.85 | 4.12 | 6.55 | 11.1 | 9.75 | 5.05 | 4.52 | 4.58 | 4.3 | 4.15 | 3.98 |
| 26 | 3.2 | 4.25 | 4.18 | 6.15 | 10.85 | 9.55 | 4.85 | 4.1 | 4.6 | 4.22 | 4.18 | 4.0 |
| 27 | 3.2 | 3.95 | 4.42 | 6.1 | 11.0 | 9.6 | 4.82 | 4.15 | 4.62 | 4.28 | 4.9 | 4.12 |
| 28 | 3.2 | 4.0 | 4.2 | 6.55 | 10.15 | 9.55 | 4.9 | 4.28 | 4.6 | 4.28 | 5.08 | 4.2 |
| 29 | 3.22 | ....... | 4.15 | 6.8 | 9.95 | 8.45 | 4.95 | 4.25 | 4.62 | 4.3 | 4.75 | 4.0 |
| 30 | 3.2 | ....... | 4.2 | 6.7 | 9.55 | 8.4 | 6.25 | 4.4 | 6.05 | 4.25 | 4.15 | 4.05 |
| 31 | 3.2 | ....... | 4.15 | ....... | 9.55 | ....... | 5.65 | 4.2 | ....... | 4.28 | ....... | 3.95 |

*Station rating table for San Juan River near Farmington, N. Mex., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.70 | 25 | 4.00 | 900 | 5.60 | 3,850 | 8.20 | 10,400 |
| 2.80 | 55 | 4.10 | 1,020 | 5.80 | 4,290 | 8.40 | 10,960 |
| 2.90 | 90 | 4.20 | 1,150 | 6.00 | 4,750 | 8.60 | 11,520 |
| 3.00 | 130 | 4.30 | 1,300 | 6.20 | 5,230 | 8.80 | 12,080 |
| 3.10 | 180 | 4.40 | 1,450 | 6.40 | 5,710 | 9.00 | 12,640 |
| 3.20 | 230 | 4.50 | 1,610 | 6.60 | 6,200 | 9.50 | 14,050 |
| 3.30 | 290 | 4.60 | 1,780 | 6.80 | 6,700 | 10.00 | 15,500 |
| 3.40 | 350 | 4.70 | 1,950 | 7.00 | 7,200 | 10.50 | 17,000 |
| 3.50 | 420 | 4.80 | 2,140 | 7.20 | 7,720 | 11.00 | 18,500 |
| 3.60 | 500 | 4.90 | 2,340 | 7.40 | 8,240 | 11.50 | 20,000 |
| 3.70 | 580 | 5.00 | 2,540 | 7.60 | 8,780 | 12.00 | 21,500 |
| 3.80 | 680 | 5.20 | 2,970 | 7.80 | 9,320 | 12.50 | 23,000 |
| 3.90 | 780 | 5.40 | 3,410 | 8.00 | 9,860 | 13.00 | 24,500 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904, and one high-water measurement made during 1905. Low-water estimates based on this table are therefore uncertain. The table has been extended beyond these limits.

*Estimated monthly discharge of San Juan River near Farmington, N. Mex., for 1905.*

[Drainage area, 6,920 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 338 | 40 | 242 | 14,880 | 0.035 | 0.040 |
| February | 2,582 | 230 | 682 | 37,880 | .099 | .103 |
| March | 3,410 | 780 | 1,625 | 99,920 | .235 | .271 |
| April | 7,460 | 1,085 | 4,290 | 255,300 | .620 | .692 |
| May | 19,100 | 4,635 | 10,110 | 621,600 | 1.46 | 1.68 |
| June | 24,800 | 10,960 | 18,270 | 1,087,000 | 2.64 | 2.94 |
| July | 8,240 | 2,180 | 3,604 | 221,600 | .521 | .601 |
| August | 3,740 | 840 | 1,747 | 107,400 | .252 | .290 |
| September | 4,870 | 1,180 | 1,673 | 99,550 | .242 | .270 |
| October | 4,635 | 1,180 | 1,690 | 103,900 | .244 | .281 |
| November | 2,708 | 1,085 | 1,306 | 77,710 | .189 | .211 |
| December | 1,300 | 840 | 1,084 | 66,650 | .157 | .181 |
| The year | 24,800 | 40 | 3,860 | 2,793,000 | .558 | 7.56 |

## ANIMAS RIVER AT DURANGO, COLO.

This station was established June 20, 1895, and has been maintained during the greater part of each year since. It was originally located at the old wagon bridge, one-fourth mile west of the railroad bridge, at Durango and about 200 feet above the Rio Grande Southern Railroad bridge. On June 20, 1901, the station was removed to a new bridge, located just below the site of the old one.

The channel is straight for 300 feet above and 400 feet below the station. Both banks are high and rocky and not liable to overflow. The bed of the stream is rocky and fairly permanent. There is but one channel at all stages, broken by the center pier of the bridge. Gage heights range from 6 to 13 feet. During the high water of 1905 such radical changes occurred in the channel as to make two rating tables necessary.

Discharge measurements are made from the bridge to which the gage is attached. The initial point for soundings is the downstream edge of the right abutment.

The gage at this station was read twice daily during 1905 by C. G. Graden. The original gage was spiked to the west side of the south end of the middle pier of the wagon bridge. The head of a bolt at the east abutment of the railroad bridge is 17.24 feet above this gage datum. During the early part of 1899 the old wagon bridge was removed and a new one was constructed a short distance below. On April 1, 1899, a gage was fastened to the central pier of this bridge. Owing to this change in the location and height of the rod there is no apparent relation between the rating tables before and after 1899. The present gage, established June 20, 1901, is a vertical 14-foot timber, fastened to the southwest corner of the center masonry pier on the downstream side of the new wagon bridge, one-eighth mile west of the railroad station at Durango. The timber is held in place by spikes driven into cracks in the masonry. The gage is referred to bench marks as follows: (1) A chiseled point at the southwest corner of the center pier of the highway bridge; elevation 16.75 feet above the zero of the gage. (2) A chiseled point on the lower side of the left abutment of the bridge; elevation, 16.84 feet above the zero of the gage. On April 1 and 2, 1903, sand and gravel were washed down by Lightner Creek, which enters about 100 feet below the bridge, and were deposited around the gage rod. On April 14, 1903, a new wire gage was established on the downstream side of the bridge in the span next the left bank. This gage was read until June 6, when it was stolen. In the meantime the sand and gravel had been washed from the foot of the old gage, from which readings were taken thereafter.

The wire gage read zero when the vertical gage read 5 feet. All 1903 readings were reduced to the datum of the vertical gage.

This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description:** Ann 18, iv, pp 283-284; Bull 140, pp 198-199; WS 16, p 146; 28, p 132; 38, p 310; 50, p 383; 66, p 97; 85, pp 35-36; 100, pp 51-52; 133, pp 183-184.

**Discharge:** Ann 18, iv, p 284; Bull 140, p 199; WS 16, p 146; 28, p 142; 38, p 310; 50, p 383; 66, p 97; 85, p 36; 100, p 52; 133, p 185.

**Discharge, monthly:** Ann 18, iv, p 285; 19 iv, p 414; 20, iv, pp 379, 403; 21, iv, p 301; 22, iv, p 394; WS 85, p 37; 100 p 54; 133, p 186.

**Discharge, yearly:** Ann 20, iv, p 59.

**Gage heights:** Bull 140, p 200; WS 11, p 72; 16, p 146; 28, p 139; 38, p 311; 50, p 384; 66, p 97; 85, p 36; 100, p 53; 133, p 185.

**Hydrographs:** Ann 18, iv, p 285; 19, iv, p 415; 20, iv, p 403; 21, iv, p 301; 22, iv, p 394.

**Rainfall and run-off relation:** Ann 20, iv, p 379.

**Rating tables:** Ann 18, iv, p 284; 19, iv, p 414; Bull 140, p 199; WS 28, p 145; 39, p 452; 52, p 520; 66, p 174; 85, p 37; 100, p 53; 133, p 186.

*Discharge measurements of Animas River at Durango, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 25 | M. C. Hinderlider | 89 | 195 | 6.14 | 8.70 | 1,198 |
| May 16 | .....do | 189 | 513 | 6.49 | 10.00 | 3,330 |
| May 20 | .....do | 189 | 756 | 6.85 | 11.00 | 5,179 |
| July 3 | O. H. Timmerman | 183 | 648 | 4.32 | 8.75 | 2,703 |
| July 13 | .....do | 158 | 435 | 3.04 | 7.90 | 1,321 |
| July 14 | .....do | 158 | 446 | 3.05 | 7.93 | 1,360 |
| July 14 | .....do | 158 | 448 | 3.16 | 8.00 | 1,417 |
| July 31 | .....do | 163 | 509 | 3.80 | 8.30 | 1,935 |
| August 7 | .....do | 156 | 407 | 2.50 | 7.75 | 1,017 |
| August 18 | .....do | 143 | 296 | 1.99 | 7.00 | 590 |
| August 30 | .....do | 143 | 273 | 1.92 | 6.90 | 525 |
| September 9 | .....do | 143 | 281 | 1.84 | 7.05 | 516 |
| September 15 | .....do | 143 | 239 | 1.64 | 6.90 | 391 |
| September 20 | .....do | 143 | 223 | 1.59 | 6.86 | 355 |
| September 28 | .....do | 143 | 244 | 1.62 | 6.90 | 396 |
| September 29 | .....do | 143 | 318 | 2.17 | 7.38 | 690 |
| October 1 | .....do | 163 | 440 | 3.66 | 8.04 | 1,514 |
| October 1 | .....do | 163 | 434 | 3.33 | 7.96 | 1,447 |
| October 2 | .....do | 163 | 390 | 2.71 | 7.80 | 1,057 |
| October 2 | .....do | 163 | 382 | 2.74 | 7.78 | 1,048 |
| October 3 | .....do | 160 | 370 | 2.54 | 7.64 | 939 |
| October 3 | .....do | 158 | 362 | 2.56 | 7.61 | 928 |
| October 5 | .....do | 158 | 324 | 2.32 | 7.42 | 757 |

*Daily gage height, in feet, of Animas River at Durango, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.6 | 9.9 | 11.9 | 9.0 | 8.2 | 7.0 | 7.8 | 6.8 | 6.7 |
| 2 | 7.8 | 10.4 | 12.05 | 8.7 | 8.0 | 7.0 | 7.7 | 6.8 | 6.7 |
| 3 | 7.8 | 10.0 | 12.3 | 8.7 | 8.0 | 7.0 | 7.5 | 6.7 | 6.6 |
| 4 | 8.0 | 9.6 | 12.6 | 8.6 | 8.0 | 7.0 | 7.5 | 6.7 | 6.6 |
| 5 | 8.1 | 9.4 | 12.45 | 8.4 | 8.0 | 7.0 | 7.5 | 6.7 | 6.6 |
| 6 | 8.2 | 8.6 | 12.0 | 8.4 | 8.0 | 7.0 | 7.3 | 6.7 | 6.6 |
| 7 | 8.2 | 8.6 | 12.0 | 8.4 | 7.9 | 7.0 | 7.3 | 6.7 | 6.6 |
| 8 | 8.4 | 8.7 | 12.5 | 8.4 | 7.7 | 7.0 | 7.2 | 6.7 | 6.6 |
| 9 | 8.4 | 8.7 | 11.9 | 8.4 | 7.7 | 7.0 | 7.2 | 6.7 | 6.6 |
| 10 | 8.5 | 8.7 | 11.8 | 8.3 | 7.5 | 7.0 | 7.0 | 6.7 | 6.6 |
| 11 | 8.6 | 8.8 | 11.6 | 8.3 | 7.6 | 7.0 | 7.0 | 6.7 | 6.6 |
| 12 | 8.6 | 8.7 | 11.7 | 8.1 | 7.6 | 6.9 | 7.0 | 6.7 | 6.6 |
| 13 | 8.7 | 8.8 | 11.7 | 8.0 | 7.5 | 6.9 | 7.0 | 6.7 | 6.6 |
| 14 | 8.6 | 9.0 | 11.5 | 8.0 | 7.3 | 6.9 | 7.0 | 6.7 | 6.6 |
| 15 | 8.6 | 9.3 | 11.5 | 8.0 | 7.3 | 6.9 | 7.0 | 6.7 | 6.6 |
| 16 | 8.7 | 9.5 | 11.3 | 8.0 | 7.2 | 6.9 | 6.9 | 6.6 | 6.6 |
| 17 | 8.8 | 10.2 | 11.4 | 8.0 | 7.2 | 6.9 | 6.9 | 6.6 | 6.6 |
| 18 | 9.0 | 11.2 | 11.4 | 8.0 | 7.1 | 6.8 | 6.9 | 6.6 | 6.6 |
| 19 | 8.9 | 11.3 | 11.3 | 8.0 | 7.1 | 6.8 | 6.9 | 6.7 | 6.6 |
| 20 | 8.9 | 11.4 | 11.3 | 8.1 | 7.0 | 6.8 | 6.9 | 6.7 | 6.6 |
| 21 | 8.9 | 11.6 | 11.1 | 8.2 | 7.0 | 6.8 | 6.8 | 6.7 | 6.6 |
| 22 | 8.8 | 11.5 | 11.2 | 8.2 | 7.0 | 6.8 | 6.8 | 6.7 | 6.6 |
| 23 | 8.9 | 11.8 | 10.8 | 8.2 | 7.0 | 6.8 | 6.8 | 6.7 | 6.6 |
| 24 | 9.1 | 11.8 | 10.5 | 8.0 | 7.2 | 6.8 | 6.8 | 6.7 | 6.6 |
| 25 | 9.4 | 11.6 | 10.3 | 7.8 | 7.0 | 6.9 | 6.8 | 6.7 | 6.6 |
| 26 | 9.3 | 11.85 | 10.0 | 7.8 | 7.0 | 6.8 | 6.8 | 6.7 | 6.6 |
| 27 | 9.3 | 11.5 | 9.6 | 7.8 | 7.0 | 7.0 | 6.8 | 6.7 | 6.6 |
| 28 | 9.6 | 11.1 | 9.5 | 8.0 | 7.0 | 7.2 | 6.8 | 6.7 | 6.6 |
| 29 | 9.8 | 10.7 | 9.1 | 8.6 | 7.0 | 9.0 | 6.8 | 6.7 | ....... |
| 30 | 9.8 | 11.25 | 9.0 | 9.0 | 7.0 | 7.8 | 6.9 | 6.7 | ....... |
| 31 | ....... | 11.6 | ....... | 8.7 | 7.0 | ....... | 6.9 | ....... | ....... |

*Station rating table for Animas River at Durango, Colo., from April 1 to June 4, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 7.60 | 550 | 8.70 | 1,340 | 9.80 | 2 980 | 10.90 | 4,970 |
| 7.70 | 600 | 8.80 | 1,450 | 9.90 | 3,150 | 11.00 | 5,160 |
| 7.80 | 650 | 8.90 | 1,570 | 10.00 | 3,320 | 11.20 | 5,550 |
| 7.90 | 700 | 9.00 | 1,700 | 10.10 | 3,490 | 11.40 | 5,950 |
| 8.00 | 760 | 9.10 | 1,840 | 10.20 | 3,670 | 11.60 | 6,350 |
| 8.10 | 820 | 9.20 | 1,990 | 10.30 | 3,850 | 11.80 | 6,750 |
| 8.20 | 890 | 9.30 | 2,150 | 10.40 | 4,050 | 12.00 | 7,150 |
| 8.30 | 960 | 9.40 | 2,310 | 10.50 | 4,210 | 12.20 | 7,590 |
| 8.40 | 1,040 | 9.50 | 2,470 | 10.60 | 4,400 | 12.40 | 8,030 |
| 8.50 | 1,130 | 9.60 | 2,640 | 10.70 | 4,590 | 12.60 | 8,470 |
| 8.60 | 1,230 | 9.70 | 2,810 | 10.80 | 4,780 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is very poorly defined Estimates based upon it are roughly approximate.

*Station rating table for Animas River at Durango, Colo., from June 5 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.60 | 240 | 7.80 | 1,160 | 9.00 | 2,930 | 10.40 | 5,030 |
| 6.70 | 290 | 7.90 | 1,290 | 9.10 | 3,080 | 10.60 | 5,330 |
| 6.80 | 350 | 8.00 | 1,430 | 9.20 | 3,230 | 10.80 | 5,630 |
| 6.90 | 410 | 8.10 | 1,580 | 9.30 | 3,380 | 11.00 | 5,930 |
| 7.00 | 470 | 8.20 | 1,730 | 9.40 | 3,530 | 11.20 | 6,230 |
| 7.10 | 540 | 8.30 | 1,880 | 9.50 | 3,680 | 11.40 | 6,550 |
| 7.20 | 610 | 8.40 | 2,030 | 9.60 | 3,830 | 11.60 | 6,870 |
| 7.30 | 690 | 8.50 | 2,180 | 9.70 | 3,980 | 11.80 | 7,190 |
| 7.40 | 770 | 8.60 | 2,330 | 9.80 | 4,130 | 12.00 | 7,510 |
| 7.50 | 850 | 8.70 | 2,480 | 9.90 | 4,280 | 12.50 | 8,310 |
| 7.60 | 940 | 8.80 | 2,630 | 10.00 | 4,430 | | |
| 7.70 | 1,040 | 8.90 | 2,780 | 10.20 | 4,730 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is fairly well defined between gage heights 6.9 feet and 8.8 feet. Above 9 feet the table is very uncertain.

*Estimated monthly discharge of Animas River at Durango, Colo., for 1905.*

[Drainage area, 812 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| April | 2,980 | 550 | 1,465 | 87,170 | 1.80 | 2.01 |
| May | 6,850 | 1,230 | 3,894 | 239,400 | 4.80 | 5.53 |
| June | 8,470 | 2,930 | 6,297 | 374,700 | 7.75 | 8.65 |
| July | 2,930 | 1,160 | 1,825 | 112,200 | 2.25 | 2.59 |
| August | 1,730 | 470 | 816 | 50,170 | 1.00 | 1.15 |
| September | 2,930 | 350 | 534 | 31,780 | .658 | .734 |
| October | 1,160 | 350 | 522 | 32,100 | .643 | .741 |
| November | 350 | 240 | 290 | 17,260 | .357 | .398 |
| December | 290 | 240 | 243 | 14,940 | .299 | .345 |
| The period | | | | 959,700 | | |

## ANIMAS RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904. It is located at the highway bridge about 1 mile northeast of Farmington, N. Mex.

The channel is straight for about 900 feet above and below the station. The right bank is a gradually sloping gravel bar, covered with small cobblestones and scattered trees and shrubs; it has been known to overflow, but this is an extremely rare occurrence. The left bank is a flat, grassy, perpendicular bank, 5 or 6 feet above low water, is lined with willows, and is not liable to overflow. The bed of the stream is composed of gravel, cobblestones, and silt, is free from vegetation, and is permanent The current is moderately swift.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is the west face of the left abutment and is marked zero with black paint on the bridge floor.

A standard chain gage, which is read twice each day by Mrs. Adellie Ricketts, is attached to the downstream side of the bridge, 40 feet from the left end. The gage scale is graduated from 2 to 7.8 feet. The length of the chain is 12.78 feet. The bench mark is a United States Geological Survey standard bench-mark tablet set into the southwest face of a 12-inch cottonwood tree about 50 feet north of the right end of the bridge; its elevation is 11.13 feet above the datum of the gage and 3.17 feet below the top of the horizontal bridge chord on which the gage box rests.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 191–195.

*Discharge measurements of Animas River near Farmington, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 24 | M. C. Hinderlider | 179 | 849 | 7.72 | 8.34 | 6,555 |
| July 6 | O. H. Timmerman | 144 | 449 | 3.59 | 6.25 | 1,611 |
| July 20 | do | 141 | 323 | 2.71 | 5.35 | 876 |
| July 27 | do | 141 | 280 | 2.45 | 5.05 | 687 |
| August 2 | do | 146 | 399 | 3.40 | 5.82 | 1,357 |
| August 9 | do | 126 | 286 | 2.56 | 5.10 | 732 |
| August 21 | do | 112 | 172 | 1.31 | 4.22 | 226 |
| August 24 | do | 107 | 139 | 1.00 | 3.92 | 139 |
| August 24 | do | 107 | 136 | 1.00 | 3.92 | 136 |
| August 26 | do | 75 | 122 | .93 | 3.90 | 114 |
| August 26 | do | 75 | 120 | .93 | 3.90 | 112 |
| September 12 | do | 107 | 139 | 1.62 | 4.19 | 226 |
| October 8 | do | 137 | 269 | 2.26 | 5.02 | 618 |

*Daily gage height, in feet, of Animas River near Farmington, N. Mex., for 1905.*

| Day | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.53 | 4.47 | 4.92 | 5.34 | 7.08 | 8.29 | 7.32 | 6.03 | 3.84 | 6.4 |
| 2 | 4.59 | 4.56 | 5.2 | 5.3 | 7.26 | 8.8 | 7.06 | 5.78 | 3.81 | 5.94 |
| 3 | 4.51 | 4.5 | 5.2 | 5.24 | 6.99 | 9.29 | 6.78 | 5.64 | 3.76 | 5.66 |
| 4 | 4.5 | 4.59 | 5.37 | 5.22 | 6.64 | 9.4 | 6.6 | 5.58 | 3.82 | 5.44 |
| 5 | 4.48 | 4.52 | 5.43 | 5.25 | 6.38 | 9.75 | 6.54 | 5.5 | 4.26 | 5.34 |
| 6 | 4.48 | 4.44 | 5.56 | 5.3 | 6.19 | 9.72 | 6.36 | 5.46 | 4.47 | 5.22 |
| 7 | 4.57 | 4.37 | 5.66 | 5.52 | 6.18 | 9.55 | 6.2 | 5.37 | 4.38 | 5.14 |
| 8 | 4.46 | 4.32 | 5.66 | 5.77 | 6.27 | 9.7 | 6.2 | 5.2 | 4.34 | 5.04 |
| 9 | 4.49 | 4.22 | 5.36 | 5.88 | 6.4 | 9.6 | 6.08 | 5.05 | 4.3 | 4.98 |
| 10 | 4.38 | 4.16 | 5.3 | 5.89 | 6.46 | 9.3 | 5.92 | 4.94 | 4.22 | 4.95 |
| 11 | 4.38 | 4.28 | 5.3 | 5.92 | 6.37 | 9.12 | 5.8 | 4.94 | 4.18 | 4.93 |
| 12 | 4.3 | 4.28 | 5.26 | 6.6 | 6.22 | 9.02 | 5.7 | 5.05 | 4.16 | 4.86 |
| 13 | 4.36 | 4.2 | 5.22 | 6.3 | 6.3 | 9.0 | 5.56 | 5.0 | 4.18 | 4.81 |
| 14 | 4.32 | 4.06 | 5.28 | 6.1 | 6.4 | 8.91 | 5.42 | 4.9 | 4.11 | 4.76 |
| 15 | 4.3 | 4.28 | 5.48 | 5.85 | 6.46 | 8.88 | 5.58 | 4.78 | 4.16 | 4.68 |
| 16 | 4.3 | 4.18 | 5.32 | 5.9 | 6.8 | 9.04 | 5.7 | 4.71 | 4.14 | 4.6 |
| 17 | 4.34 | 4.3 | 5.28 | 5.94 | 7.32 | 8.68 | 5.51 | 4.66 | 4.07 | 4.58 |
| 18 | 4.38 | 4.3 | 5.36 | 5.91 | 7.67 | 8.52 | 5.4 | 4.53 | 4.0 | 4.57 |
| 19 | 4.38 | 4.33 | 5.54 | 5.92 | 7.82 | 8.49 | 5.35 | 4.41 | 3.96 | 4.54 |
| 20 | 4.36 | 4.3 | 5.52 | 5.9 | 7.98 | 8.36 | 5.32 | 4.36 | 3.96 | 4.5 |
| 21 | 4.48 | 4.34 | 5.46 | 5.91 | 8.02 | 8.14 | 5.38 | 4.28 | 3.94 | 4.47 |
| 22 | 4.31 | 4.32 | 5.36 | 5.92 | 7.98 | 8.0 | 5.33 | 4.16 | 3.94 | 4.46 |
| 23 | 4.26 | 4.42 | 5.3 | 6.05 | 8.1 | 7.84 | 5.38 | 4.07 | 3.93 | 4.48 |

*Daily gage height, in feet, of Animas River near Farmington, N. Mex., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 4.24 | 4.58 | 5.2 | 6.3 | 8.35 | 7.9 | 5.3 | 3.96 | 3.92 | 4.47 |
| 25 | 4.26 | 4.75 | 5.16 | 6.13 | 8.54 | 7.84 | 5.2 | 3.91 | 4.04 | 4.46 |
| 26 | 4.24 | 4.84 | 5.23 | 6.12 | 8.58 | 7.72 | 5.14 | 3.92 | 4.55 | 4.4 |
| 27 | 4.4 | 4.75 | 5.33 | 6.04 | 8.63 | 7.72 | 5.06 | 4.05 | 4.4 | 4.36 |
| 28 | 4.39 | 4.68 | 5.4 | 6.26 | 8.38 | 7.7 | 5.06 | 4.04 | 4.38 | 4.35 |
| 29 | 4.39 | ........ | 5.29 | 6.49 | 8.02 | 7.59 | 5.09 | 3.96 | 4.47 | 4.34 |
| 30 | 4.36 | ........ | 5.3 | 6.75 | 7.56 | 7.48 | 6.23 | 3.91 | 6.5 | 4.33 |
| 31 | 4.34 | ........ | 5.3 | ........ | 7.75 | ........ | 6.4 | 3.88 | ........ | 4.33 |

*Station rating table for Animas River near Farmington, N. Mex., from October 20, 1904, to May 16, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.20 | 125 | 5.00 | 450 | 5.80 | 1,145 | 6.60 | 2,400 |
| 4.30 | 150 | 5.10 | 510 | 5.90 | 1,265 | 6.70 | 2,580 |
| 4.40 | 177 | 5.20 | 580 | 6.00 | 1,385 | 6.80 | 2,760 |
| 4.50 | 208 | 5.30 | 655 | 6.10 | 1,530 | 6.90 | 2,940 |
| 4.60 | 243 | 5.40 | 735 | 6.20 | 1,700 | 7.00 | 3,120 |
| 4.70 | 287 | 5.50 | 825 | 6.30 | 1,870 | 7.10 | 3,300 |
| 4.80 | 337 | 5.60 | 925 | 6.40 | 2,040 | 7.20 | 3,485 |
| 4.90 | 390 | 5.70 | 1,030 | 6.50 | 2,220 | 7.30 | 3,670 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 7 discharge measurements made after October 25, 1904, and is well defined.

*Station rating table for Animas River near Farmington, N. Mex., from May 17 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.70 | 65 | 4.90 | 570 | 6.10 | 1,665 | 7.60 | 4,560 |
| 3.80 | 95 | 5.00 | 630 | 6.20 | 1,800 | 7.80 | 5,055 |
| 3.90 | 125 | 5.10 | 695 | 6.30 | 1,945 | 8.00 | 5,575 |
| 4.00 | 155 | 5.20 | 765 | 6.40 | 2,100 | 8.20 | 6,135 |
| 4.10 | 190 | 5.30 | 840 | 6.50 | 2,265 | 8.40 | 6,735 |
| 4.20 | 225 | 5.40 | 920 | 6.60 | 2,435 | 8.60 | 7,370 |
| 4.30 | 265 | 5.50 | 1,005 | 6.70 | 2,615 | 8.80 | 8,025 |
| 4.40 | 310 | 5.60 | 1,095 | 6.80 | 2,800 | 9.00 | 8,700 |
| 4.50 | 355 | 5.70 | 1,195 | 6.90 | 2,995 | 9.20 | 9,380 |
| 4.60 | 405 | 5.80 | 1,300 | 7.00 | 3,200 | 9.40 | 10,060 |
| 4.70 | 455 | 5.90 | 1,415 | 7.20 | 3,630 | 9.60 | 10,740 |
| 4.80 | 510 | 6.00 | 1,535 | 7.40 | 4,085 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1905. It is well defined between gage heights 3.9 feet and 5.8 feet.

*Estimated monthly discharge of Animas River near Farmington, N. Mex., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 239 | 135 | 176 | 10,820 |
| February | 358 | 95 | 186 | 10,330 |
| March | 988 | 402 | 695 | 42,730 |
| April | 2,670 | 595 | 1,338 | 79,620 |
| May | 7,468 | 1,666 | 3,962 | 243,600 |
| June | 11,250 | 4,273 | 7,655 | 455,500 |
| July | 3,901 | 669 | 1,448 | 89,030 |
| August | 1,574 | 119 | 534 | 32,830 |
| September | 2,265 | 83 | 275 | 16,360 |
| October | 2,100 | 278 | 576 | 35,420 |
| The period | | | | 1,016,000 |

## LA PLATA RIVER AT HESPERUS, COLO.

This station was established June 14, 1904, in connection with investigations relating to the La Plata project in New Mexico. It is located at the highway bridge on the west side of Hesperus, Colo.

The channel is straight for about 50 feet above and below the station. Both banks are low and covered with brush and scattered trees, but neither is liable to overflow. The bed of the stream is composed of large and small cobblestones, but is not permanent. A small island above the bridge, dead water at low stages, and a tortuous channel below the bridge affect the accuracy of meter measurements at the bridge. The current is swift. The fall of the river, according to levels run by the La Plata Ditch Company for about 10 miles, is 135 feet per mile. Gage heights range from 0.8 foot to 3.5 feet.

Discharge measurements are made by wading at suitable points along the stream at low stages, as the conditions at the bridge are at some stages unfavorable to careful gagings. At high stages measurements are made from the wooden wagon bridge on the west side of Hesperus. The initial point for soundings is a nail driven into the downstream side of the wagon bridge over the south face of the north abutment.

The gage was read twice daily during 1905 by Fred Harrison. The original gage was a 4-foot board graduated from zero to 3.9 feet. This gage was spiked to the upstream end of the south face of the north abutment, with the zero mark resting on the bed of the river. The bench mark is a nail driven horizontally into the west face of a 12-inch cottonwood tree about 8 inches above the ground, about 75 feet northeast of the gage rod, on the right bank of the river; elevation, 9.15 feet above the zero of the gage. On account of the boiling action of the water at this gage, a new staff gage was installed on April 26, 1905. The new gage is graduated from zero to 5.2 feet and is spiked in a vertical position to the south face of the north abutment on the downstream side of the bridge. The datum of the new gage is not the same as that of the old, being 8.09 feet below the above bench mark.

On August 20, 1905, it was found necessary to transfer this gage to the north face of the south abutment downstream side of the bridge where it is now located. Elevation of gage datum same as that last described, viz, 8.09 feet below the bench mark.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pp. 195-196.

*Discharge measurements of La Plata River at Hesperus, Colo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 26 | M. C. Hinderlider | 29 | 35 | 2.86 | 1.20 | 100 |
| July 4 | O. H. Timmerman | 29 | 32 | 3.94 | 1.70 | 126 |
| July 4 | do | 29 | 33 | 3.85 | 1.70 | 127 |
| July 15 | do | 29 | 19 | 2.29 | 1.25 | 44 |
| July 17 | do | 29 | 16 | 2.60 | 1:15 | 42 |
| July 29 | do | 29 | 21 | 2.90 | 1.31 | 61 |
| August 5 | do | 29 | 19 | 2.39 | 1.28 | 45 |
| August 29 | do | 23 | 11 | 1.51 | .95 | 16 |
| September 4 | do | 16 | 28 | .96 | 1.00 | 27 |
| September 30 | do | 29 | 24 | 2.67 | 1.70 | 63 |
| September 30 | do | 29 | 21 | 2.53 | 1.55 | 54 |

**Note.**—Gage heights refer to datum of April 26, 1905.

*Daily gage height, in feet, of La Plata River at Hesperus, Colo., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.92 | 2.7 | 1.9 | 1.25 | 0.92 | 1.32 | 0.92 | 1.18 |
| 2 | | 1.88 | 2.85 | 1.9 | 1.2 | .92 | 1.22 | .9 | 1.3 |
| 3 | | 1.62 | 2.85 | 1.75 | 1.2 | .92 | 1.18 | .9 | 1.1 |
| 4 | | 1.5 | 3.15 | 1.68 | 1.18 | 1.0 | 1.18 | .9 | 1.0 |
| 5 | | 1.3 | 2.85 | 1.65 | 1.18 | .92 | 1.18 | .9 | 1.0 |
| 6 | | 1.25 | 2.8 | 1.55 | 1.18 | .92 | 1.18 | .9 | .95 |
| 7 | | 1.22 | 2.9 | 1.48 | 1.15 | .92 | 1.12 | .95 | .9 |
| 8 | | 1.5 | 3.1 | 1.45 | 1.1 | .92 | 1.12 | .88 | .9 |
| 9 | | 1.48 | 2.9 | 1.35 | 1.02 | .92 | 1.1 | .85 | .85 |
| 10 | | 1.32 | 2.9 | 1.35 | 1.02 | .92 | 1.1 | .85 | .85 |
| 11 | | 1.38 | 2.8 | 1.3 | 1.02 | .92 | 1.1 | .85 | .85 |
| 12 | | 1.4 | 2.85 | 1.22 | 1.02 | .92 | 1.1 | .9 | .85 |
| 13 | | 1.4 | 2.8 | 1.22 | 1.0 | .92 | 1.1 | .9 | .88 |
| 14 | | 1.45 | 2.95 | 1.22 | 1.0 | .92 | 1.1 | .85 | .88 |
| 15 | | 1.68 | 3.3 | 1.2 | 1.0 | .92 | 1.1 | .85 | .85 |
| 16 | | 1.9 | 3.0 | 1.18 | .98 | .9 | 1.1 | .85 | .85 |
| 17 | | 2.0 | 2.9 | 1.18 | .98 | .9 | 1.05 | .85 | .82 |
| 18 | | 2.18 | 2.75 | 1.12 | .92 | .9 | 1.0 | .9 | .8 |
| 19 | | 2.45 | 2.5 | 1.12 | .92 | .9 | 1.0 | .8 | .8 |
| 20 | | 2.15 | 2.55 | 1.15 | .92 | .9 | 1.0 | .8 | .8 |
| 21 | | 2.25 | 2.45 | 1.15 | .92 | .9 | 1.0 | .85 | .8 |
| 22 | | 2.6 | 2.45 | 1.15 | .92 | .9 | 1.0 | .9 | .75 |
| 23 | | 2.35 | 2.45 | 1.12 | .92 | .9 | 1.0 | .92 | .75 |
| 24 | | 2.45 | 2.35 | 1.15 | .92 | .9 | 1.0 | 1.05 | .7 |
| 25 | | 2.65 | 2.35 | 1.1 | .92 | .9 | 1.0 | 1.1 | .7 |
| 26 | 1.35 | 2.85 | 2.35 | 1.1 | .92 | .9 | 1.0 | 1.1 | .95 |
| 27 | 1.38 | 2.4 | 2.25 | 1.12 | .92 | .9 | .95 | 1.12 | .78 |
| 28 | 1.6 | 2.3 | 2.15 | 1.1 | .92 | .9 | .95 | 1.15 | .5 |
| 29 | 1.65 | 2.3 | 2.05 | 1.32 | .92 | 1.92 | .95 | 1.1 | .5 |
| 30 | 1.78 | 2.4 | 2.0 | 1.3 | .92 | 1.55 | .92 | 1.15 | .5 |
| 31 | | 2.65 | | 1.3 | .92 | | .9 | | .45 |

**Note.**—Gage heights refer to datum of April 26, 1905.

## LA PLATA RIVER NEAR LA PLATA, N. MEX.

This station was established June 1, 1905, in connection with investigations relating to the La Plata project. It is located on the single-span wooden highway bridge 1 mile southeast of La Plata post-office, N. Mex., in sec. 3, T. 31, R. 13 W., below all points of diversion.

The channel is straight for 50 feet above the bridge, beyond which it bends to the right; below the bridge it is straight for 300 feet. The left bank is well defined but is liable to overflow at high stages. During high water the right bank overflows below the bridge but does not overflow above. Both banks are lined with sagebrush and willows. There is but one channel at all stages. Gage heights range from 1 foot to 4.5 feet. At gage height of 1 foot the river is dry.

Discharge measurements are made from the downstream side of the bridge.

The gage, which was read twice each day during 1905 by Frank Williams, is a vertical staff graduated from 3 to 10.1 feet, spiked to the northwest corner of the east abutment of the bridge. The 3-foot mark rests on the bed of the stream and the 9.4-foot mark is even with the surface of the bridge floor. The gage is referred to bench marks as follows: (1) The head of a 20-penny spike driven vertically into the top of the second log from the bottom at the northeast corner of Mr. Williams's house; elevation, 21.37 feet above the zero of the gage. (2) A nail driven into the spur root on the south side of a cottonwood tree southeast of house; elevation, 19.47 feet above the zero of the gage.

*Discharge measurements of La Plata River near La Plata, N. Mex., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 25 | M. C. Hinderlider | 36 | 107 | 5.22 | 4.40 | 599 |
| July 7 | O. H. Timmerman | | | | 1.10 | [a]3 |
| July 10 | do | | | | | [a].4 |
| July 26 | do | | | | | [a]2.0 |

[a] Estimated.

*Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 3.49 | 2.32 | (a) | (a) | 4.11 | (a) | 1.3 |
| 2 | | 3.78 | 1.84 | (a) | (a) | 3.86 | (a) | 1.3 |
| 3 | | 3.92 | 1.46 | (a) | (a) | 3.62 | (a) | 1.3 |
| 4 | | 4.01 | 1.09 | (a) | (a) | 3.08 | (a) | 1.3 |
| 5 | | 4.26 | 1.14 | (a) | (a) | 1.74 | 1.52 | 1.3 |
| 6 | | 3.42 | 1.09 | (a) | (a) | 1.14 | (a) | 1.3 |
| 7 | | 4.32 | 1.09 | (a) | (a) | (a) | (a) | 1.2 |
| 8 | | 4.51 | 1.14 | (a) | (a) | (a) | (a) | 1.2 |
| 9 | | 3.72 | 1.14 | (a) | (a) | (a) | (a) | 1.2 |
| 10 | | 3.48 | 1.09 | (a) | (a) | (a) | (a) | 1.2 |
| 11 | | 3.77 | 1.09 | (a) | (a) | (a) | (a) | 1.2 |
| 12 | | 3.67 | 1.09 | (a) | (a) | (a) | (a) | 1.2 |
| 13 | | 4.36 | 1.09 | (a) | (a) | (a) | (a) | 1.2 |
| 14 | | 3.47 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 15 | | 3.57 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 16 | | 3.47 | (a) | (a) | (a) | (a) | (a) | 1.2 |

[a] Standing in pools.

*Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1905*—Continued.

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 17 | | 3.37 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 18 | | 3.27 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 19 | | 3.22 | 1.44 | (a) | (a) | (a) | (a) | 1.2 |
| 20 | | 3.07 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 21 | | 2.98 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 22 | | 2.83 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 23 | | 2.79 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 24 | | 2.6 | (a) | (a) | (a) | (a) | (a) | 1.2 |
| 25 | 4.33 | 2.46 | (a) | (a) | (a) | (a) | 1.20 | 1.2 |
| 26 | 4.28 | 2.49 | 1.84 | (a) | (a) | (a) | (a) | 1.2 |
| 27 | 3.76 | 2.42 | 1.39 | (a) | (a) | (a) | 1.48 | 1.2 |
| 28 | 3.77 | 2.42 | 1.19 | (a) | (a) | (a) | 1.32 | 1.2 |
| 29 | 3.37 | 2.22 | 1.09 | (a) | 4.4 | (a) | 1.3 | 1.2 |
| 30 | 3.2 | 2.22 | 1.09 | (a) | 4.36 | (a) | 1.3 | 1.2 |
| 31 | 3.28 | | (a) | | | (a) | | 1.2 |

[a] Standing in pools.

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the San Juan basin in 1905:

*Miscellaneous discharge measurements made in San Juan River drainage basin in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| July 17 | Boyle ditch | Hesperus, Colo | 4 | 3.4 | 3.59 | 12.2 |
| September 2 | do | do | | 1.5 | 1.00 | 1.5 |
| October 4 | do | do | | | | .2 |
| September 18 | do | Kline, Colo | | | | .00 |
| July 17 | Brown Bros. ditch | Hesperus, Colo | | | | .3 |
| September 18 | do | do | | 1.5 | 1.00 | 1.5 |
| August 10 | Enterprise ditch | La Plata, Colo | | | | (a) |
| September 18 | Fort Lewis ditch No.1. | Fort Lewis, Colo | | 2.0 | 1.00 | [b]2 |
| Do | Fort Lewis ditch No.2. | do | | 1.0 | 1.00 | [b]1 |
| July 17 | Fort Lewis ditch | Hesperus, Colo | | .8 | 1.00 | .8 |
| July 18 | Freed ditch | Kline, Colo | | | | (a) |
| September 18 | do | do | | | | (a) |
| Do | Green canal | do | | | | (a) |
| July 17 | H. and H. ditch | Hesperus, Colo | 4.7 | 4.2 | 1.02 | 4.3 |
| September 18 | do | do | | 2.0 | 1.00 | [b]2 |
| July 17 | Hay Gulch ditch | do | 5 | 5.8 | 2.48 | 14.41 |
| September 2 | do | do | 4 | 3.2 | 1.91 | 6.1 |
| September 7 | do | do | 5.6 | 3.01 | 5.28 | 15.92 |
| September 30 | do | do | 5.6 | 5.0 | 4.42 | 22.1 |
| July 18 | Helton ditch | Kline, Colo | 4 | 2.0 | 1.10 | 2.2 |
| September 18 | do | do | | | | (a) |
| July 17 | Indian ditch | Hesperus, Colo | | 1.0 | .75 | .8 |
| July 17 | Kellar ditch | do | | | | (a) |
| April 26 | La Plata canal | do | | | | 8.8 |
| July 4 | do | do | 10 | 9.2 | .66 | 6.1 |
| July 15 | do | do | 4 | 2.8 | 2.29 | 6.4 |

[a] Dry. [b] Estimated.

*Miscellaneous discharge measurements made in San Juan River drainage basin in 1905*—Continued.

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| July 17 | La Plata canal | Hesperus, Colo | 4 | 1.6 | 1.75 | 2.8 |
| July 29 | do | do | 4 | 2.4 | 2.42 | 5.8 |
| August 5 | do | do | 4 | 1.6 | 1.06 | 1.7 |
| September 2 | do | do | 4 | 2.4 | 1.21 | 2.9 |
| September 4 | do | do | 4 | 2.0 | 1.35 | 27.1 |
| July 15 | La Plata and Cherry Creek ditch. | do | 4.8 | 3.4 | 5.68 | 19.93 |
| September 2 | do | do | | 2.0 | 1.0 | [a] 2.0 |
| September 30 | do | do | | | | (b) |
| October 4 | do | do | | | | (b) |
| April 25 | Lightner Creek | Durango, Colo | | | | 17.7 |
| July 14 | do | do | | | | [a] 6.5 |
| July 31 | do | do | | | | [a] 6 |
| August 7 | do | do | | | | [a] 7 |
| September 9 | do | do | | | | [a] 9 |
| September 15 | do | do | | | | [a] 7 |
| September 20 | do | do | | | | [a] 6 |
| October 1 | do | do | | | | [a] 7 |
| October 4 | Placer ditch | Hesperus, Colo | | | | (b) |
| July 15 | Parrott ditch | do | | | | (b) |
| September 16 | do | do | | | | (b) |
| October 4 | do | do | | | | (b) |
| September 30 | Parrott City canal | Parrott City, Colo | | | | (b) |
| September 2 | Ramott canal | Hesperus, Colo | | | | (b) |
| July 18 | Revival ditch | | 2 | 1.0 | 1.00 | 1.00 |
| July 17 | Short Line ditch | Hesperus, Colo | 4 | 1.2 | .92 | 1.1 |
| September 18 | do | Kline, Colo | | | | (b) |
| July 17 | Slate ditch | | 8 | 4.8 | 2.17 | 10.4 |
| July 18 | Stinebaugh ditch | | | | | (b) |
| September 5 | Steinmegger canal | Hesperus, Colo | | | | (b) |
| July 17 | Trainor ditch | Kline, Colo | | | | (a).5 |
| September 18 | do | do | | | | (b) |
| Do | Ute Indian ditch | Fort Lewis, Colo | | | | (b) |
| July 18 | Warren ditch | | | | | (b) |

[a] Estimated.

[b] Dry.

# LITTLE COLORADO RIVER DRAINAGE BASIN.

## DESCRIPTION OF BASIN.

The country drained by the Little Colorado River consists of a high plateau with an elevation over 4,000 feet above sea level, extending from the Continental Divide in northwestern New Mexico westward to the San Francisco Mountains in Arizona, and from the Grand Canyon of the Colorado southward to the Mogollon Mesa. The greater part of this plateau is composed of rolling plains with a few feet of soil at the surface underlain by rock. Through this plateau the river winds northwestward to its junction with the great Colorado.

The run-off from approximately 6,000 square miles of the drainage area finds its way into the Little Colorado above the mouth of Rio Puerco, the largest tributary which joins the main stream 2 miles above the town of Holbrook, Ariz. Both the Little Colorado and the Rio Puerco are flashy streams, seldom clear even during low stages. They have shifting, sandy bottoms, and when not confined in canyons the stream beds are wide with abrupt earth banks. The discharge fluctuates greatly, being insignificant in dry seasons. The floods are short and violent and carry large quantities of silt in suspension.

## LITTLE COLORADO RIVER AT WOODRUFF, ARIZ.

This station was established March 16, 1905. It is located about 100 yards below the crossing of the Holbrook-Winslow wagon road and one-fourth mile below the Woodruff dam.

The channel is straight for 300 feet above and 100 feet below the station. The banks are high, with some brush, and neither is liable to overflow. The bed of the stream is composed of sand. The current is swift at high and medium stages of water.

Discharge measurements are made by means of a cable, car, and tag wire. The initial point for soundings is the iron hook on the chain connecting the cable with anchorage on left or west bank of stream.

The gage is observed twice each day by R. L. Newman. The original gage was a combined vertical and inclined rod located on the right or east bank of the stream about 60 feet below the measuring section. This gage was destroyed on May 3, 1905, by high water, caused by the breaking of the St. John and Woodruff dams. It was replaced on May 6, 1905, with a temporary gage, which was used until July 30, 1905, when a permanent gage was installed at the original location. The bench mark is a nail driven into a 6-inch cottonwood tree 23 feet N. 10° W. from east end of gage. The original elevation of this bench mark was 19.40 feet above the zero of the gage. This tree was so bent over by the rush of water on May 3 that the bench mark is about 0.05 foot lower than it was originally. The zero of the gage established July 30, 1905, was set 13.03 feet below the elevation of the bench mark, or approximately 13.07 feet below the original elevation. On July 30, 1905, the water stood at 5.0 feet on the temporary gage set by the observer May 6, and registered 0.8 foot at the same time on the new permanent gage.

*Discharge measurements of Little Colorado River at Woodruff, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Dis-charge. | Date. | Hydrographer. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| Mar. 22 | W. A. Farish | 9.25 | 736 | September 27 | R. L. Newman | 2.1 | 137 |
| May 1 | do | 7.4 | 480 | September 28 | do | 1.4 | 66 |
| July 31 | Newman and Farish. | 3.05 | 459 | September 29 | do | 1.7 | 178 |
| August 3 | R. L. Newman | .8 | 54 | September 30 | do | 1.3 | 80 |
| August 4 | do | .5 | 28 | October 1 | do | 1.0 | 63 |
| August 6 | do | .3 | 18.1 | October 3 | do | .8 | 32 |
| August 7 | do | .5 | 30 | October 4 | do | 0.8 | 30 |
| August 8 | do | .8 | 49 | October 6 | do | 0.7 | 35 |
| August 9 | do | .5 | 45 | October 7 | do | 0.7 | 35 |
| August 10 | do | .5 | 53 | October 8 | do | 0.7 | 22 |
| August 11 | do | 1.3 | 201 | October 10 | do | 0.6 | 15.4 |
| August 13 | do | .4 | 94 | October 12 | do | 0.6 | 15.1 |
| August 14 | do | .5 | 58 | October 13 | do | 6.6 | 13.8 |
| August 15 | do | .4 | 77 | October 14 | do | 0.6 | 11.5 |
| August 16 | do | .3 | 44 | October 16 | do | 0.5 | 16 |
| August 17 | do | .3 | 46 | October 17 | do | 0.5 | 14.8 |
| August 18 | do | .3 | 12 | October 19 | do | 0.5 | 14.8 |
| August 19 | do | .1 | 6.2 | October 20 | do | 0.5 | 15.1 |
| August 22 | do | .0 | 9.3 | October 21 | do | 0.5 | 14.7 |
| August 24 | do | 1.3 | 132 | October 23 | do | 0.4 | 12.8 |
| August 25 | do | 1.1 | 99 | October 24 | do | 0.4 | 12.7 |
| August 27 | do | 3.7 | 342 | October 25 | do | 0.4 | 13.4 |
| August 29 | do | .5 | 30 | October 26 | do | 0.4 | 12.5 |
| August 31 | do | .5 | 17.4 | October 27 | do | 0.4 | 13.6 |
| September 1 | do | .3 | 13.1 | October 28 | do | 0.4 | 13.7 |
| September 3 | do | .3 | 17.7 | October 30 | do | 0.4 | 11.6 |
| September 4 | do | .2 | 11.4 | October 31 | H. S. Reed | 0.4 | 14.4 |
| September 6 | do | 6 | 1,216 | October 31 | do | 0.4 | 14 |
| September 7 | do | 1.4 | 131 | November 1 | R. L. Newman | 6.4 | 11 |
| September 9 | do | 1.4 | 114 | November 7 | do | 1.0 | 39 |
| September 11 | do | .5 | 33 | November 8 | do | 1.0 | 38 |
| September 12 | do | .5 | 28 | November 9 | do | 3.35 | 249 |
| September 13 | do | .3 | 17.8 | November 10 | do | 1.4 | 52 |
| September 14 | do | .3 | 19 | November 11 | do | 1.1 | 38 |
| September 16 | do | .2 | 13.7 | November 20 | do | .7 | 25 |
| September 20 | do | .1 | 8 | November 21 | do | 1.5 | 67 |
| September 21 | do | .1 | 8.3 | November 22 | do | 2.0 | 130 |
| September 23 | do | .1 | 8.7 | November 23 | do | 2.7 | 172 |
| September 24 | do | 4.75 | 880 | November 24 | do | 1.2 | 46 |
| September 25 | do | 3.7 | 657 | November 25 | do | 1.0 | 33 |

*Daily gage height, in feet, of Little Colorado River at Woodruff, Ariz., for 1905.*

| Day. | Mar | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 5.9 | 7.5 | 3.65 | 2,0 | 2.4 | 0.3 | 1.1 | 0.4 | 1.7 |
| 2 | ........ | 8.05 | 6.95 | 3.6 | 2.0 | 1.55 | .6 | .95 | .4 | 1.55 |
| 3 | ........ | 11.2 | 19.65 | 3.5 | 2.0 | .8 | .25 | .8 | .4 | 1.45 |
| 4 | ........ | 11.1 | 11.5 | 3.45 | 1.95 | .5 | .75 | .75 | 4.0 | 1.3 |
| 5 | ........ | 12.4 | 9.75 | 3.4 | 1.9 | .3 | .75 | .7 | 2.2 | 1.3 |
| 6 | ........ | 12.8 | 8.75 | 3.35 | 1.9 | .3 | 2.5 | .7 | 1.15 | 1.2 |
| 7 | ........ | 12.15 | 8.0 | 3.25 | 1.9 | .5 | 1.7 | .7 | .9 | 1.05 |
| 8 | ........ | 11.4 | 7.5 | 3.85 | 1.9 | .65 | 1.4 | 65 | 1.65 | .8 |
| 9 | ........ | 10.15 | 7.0 | 3.95 | 2.8 | .6 | 1.35 | .6 | 2.65 | .7 |
| 10 | ........ | 10.0 | 6.5 | 3.75 | 2.7 | .5 | .95 | .6 | 1.4 | .7 |
| 11 | ........ | 8.25 | 7.25 | 3.45 | 2.6 | .9 | .6 | .6 | 1.1 | .7 |
| 12 | ........ | 12.3 | 7.55 | 3.2 | 2.5 | .55 | .5 | .6 | 1.0 | .55 |
| 13 | ........ | 13.4 | 5.95 | 3.2 | 2.4 | .45 | .35 | .6 | 1.0 | .75 |
| 14 | ........ | 9.2 | 5.4 | 3.2 | 2.3 | .4 | .3 | .6 | .9 | .6 |
| 15 | ........ | 8.65 | 5.35 | 3.15 | 2.25 | .4 | .3 | .5 | .85 | .5 |
| 16 | 7.4 | 7.4 | 4.95 | 3.1 | 2.0 | .3 | .2 | .5 | .8 | .5 |
| 17 | 10.3 | 6.7 | 4.75 | 3.05 | 1.95 | .3 | .2 | .5 | .8 | .5 |
| 18 | 10.45 | 6.3 | 4.6 | 3.0 | 1.9 | .25 | .2 | .5 | .8 | .5 |
| 19 | 9.75 | 5.9 | 4.5 | 3.0 | 2.1 | .1 | .1 | .5 | .75 | .5 |
| 20 | 9.45 | 5.45 | 4.45 | 2.5 | 3.6 | .0 | .1 | .5 | .7 | .6 |
| 21 | 12.4 | 5.65 | 4.4 | 2.0 | 2.0 | .0 | .1 | .5 | .7 | .6 |
| 22 | 8.05 | 5.25 | 4.3 | 2.0 | 1.95 | .0 | .1 | .5 | 1.35 | .6 |
| 23 | 7.85 | 5.3 | 4.35 | 2.0 | 2.05 | .0 | .15 | .4 | 2.3 | .55 |
| 24 | 7.35 | 8.9 | 4.25 | 2.0 | 2.0 | .65 | 3.95 | .4 | 1.25 | .5 |
| 25 | 7.35 | 11.95 | 4.2 | 2.0 | 1.9 | 1.15 | 4.55 | .4 | 1.1 | .4 |
| 26 | 6.95 | 18.55 | 4.1 | 2.0 | 2.15 | .8 | 4.0 | .4 | 1.0 | .4 |
| 27 | 6,3 | 13.55 | 4.1 | 2.0 | 2.05 | 2.85 | 1.9 | .4 | 21.9 | .4 |
| 28 | 6.3 | 9.9 | 4.0 | 2.0 | 2.1 | 1.35 | 1.35 | .4 | 7.75 | .4 |
| 29 | 6.4 | 8.05 | 4.0 | 2.0 | 5.2 | 0.5 | 1.6 | .4 | 5.5 | .35 |
| 30 | 6.7 | 7.85 | 4.0 | 2.0 | 7.25 | .5 | 1.4 | .4 | 2.0 | .3 |
| 31 | 5.7 | ........ | 3.8 | ........ | 4.75 | .5 | ........ | .4 | ........ | .3 |

*Daily discharge, in second-feet, of Little Colorado River at Woodruff, Ariz., for 1905.*

| Day. | Mar. | Apr. | May. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 320 | 492 | 317 | 13 | 80 | 12 | 72 |
| 2 | | 560 | 432 | 145 | 32 | 53 | 12 | 65 |
| 3 | | 1,028 | 2,296 | 54 | 15 | 32 | 12 | 62 |
| 4 | | 1,013 | | 28 | 47 | 26 | 323 | 56 |
| 5 | | 1,208 | | 18 | 47 | 22 | 126 | 56 |
| 6 | | 1,268 | | 18 | 948 | 35 | 42 | 52 |
| 7 | | 1,170 | | 29 | 190 | 35 | 36 | 47 |
| 8 | | 1,058 | | 38 | 122 | 18 | 80 | 39 |
| 9 | | 870 | | 53 | 80 | 15 | 167 | 36 |
| 10 | | 848 | | 53 | 65 | 15 | 52 | 36 |
| 11 | | 589 | | 122 | 40 | 15 | 38 | 36 |
| 12 | | 1,193 | | 93 | 28 | 15 | 36 | 32 |
| 13 | | 1,358 | | 100 | 20 | 14 | 36 | 37 |
| 14 | | 728 | | 49 | 19 | 12 | 32 | 33 |
| 15 | | 646 | | 47 | 19 | 15 | 31 | 30 |
| 16 | 481 | 481 | | 44 | 14 | 15 | 29 | 30 |
| 17 | 893 | 404 | | 46 | 14 | 15 | 29 | 30 |
| 18 | 916 | 362 | | 10 | 14 | 15 | 29 | 30 |
| 19 | 810 | 320 | | 6 | 8 | 15 | 26 | 30 |
| 20 | 766 | 274 | | 5 | 8 | 15 | 25 | 33 |
| 21 | 1,208 | 294 | | 5 | 8 | 15 | 25 | 33 |
| 22 | 562 | 254 | | 9 | 8 | 15 | 71 | 33 |
| 23 | 534 | 259 | | 9 | 10 | 13 | 135 | 32 |
| 24 | 475 | 683 | | 54 | 684 | 13 | 44 | 30 |
| 25 | 475 | 1,140 | | 106 | 868 | 13 | 36 | 28 |
| 26 | 432 | 2,030 | | 64 | 848 | 13 | 33 | 28 |
| 27 | 362 | 1,380 | | 166 | 234 | 13 | 10,000 | 28 |
| 28 | 362 | 830 | | 46 | 118 | 13 | 2,960 | 28 |
| 29 | 372 | 561 | | 30 | 155 | 13 | 1,735 | 27 |
| 30 | 404 | 534 | | 23 | 92 | 13 | 85 | 25 |
| 31 | 299 | | | 17 | | 13 | | 25 |

NOTE.—Owing to no measurements being made during May, June, and July, no estimates have been made. Discharge obtained by indirect method.

*Estimated monthly discharge of Little Colorado River at Woodruff, Ariz., for 1905.*

[Drainage area, 6,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 16-31 | 1,208 | 299 | 584 | 18,530 | 0.097 | 0.058 |
| April | 2,030 | 254 | 789 | 46,950 | .132 | .147 |
| August | 317 | 5 | 58.2 | 3,579 | .0097 | .011 |
| September | 948 | 8 | 159 | 9,461 | .026 | .029 |
| October | 80 | 12 | 20.1 | 1,236 | .0034 | .0039 |
| November | 10,000 | 12 | 543 | 32,310 | .090 | .100 |
| December | 72 | 25 | 37.4 | 2,300 | .0062 | .0072 |
| The period | | | | 114,400 | | |

## LITTLE COLORADO RIVER AT HOLBROOK, ARIZ.

This station was established March 17, 1905. It is located at the county bridge across Little Colorado River at Holbrook, Ariz.

The channel is straight for about 300 feet both above and below the station. A stone jetty along the side of the wagon road forms the right bank; the left bank is clean and does not overflow. The bed of the stream is sand to an average depth of 3 to 5 feet, and is very unstable. The entire flow of the river passes under the bridge; but as the section is wide the current does not always flow at right angles to the bridge.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the face of the bridge abutment on west bank of stream. Soundings are taken at each of the floor beams.

The gage, which was read twice each day during 1905 by Mrs. Anna Connor, is a staff fastened in an upright position to the downstream face of the first pier from the west bank. The gage is referred to bench marks as follows: (1) The corner of the top of the bridge pier to which the gage is fastened; elevation, 11.80 feet above the zero of the gage. (2) The bottom outside edge of the bridge chord; elevation, 12.73 feet above the zero of the gage.

*Discharge measurements of Little Colorado River at Holbrook, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| March 20 | W. A. Farish | 5.9 | 942 | September 18 | R. L. Newman | 2.9 | 11 |
| March 21 | do | 6.6 | 1,380 | September 19 | do | 2.9 | 11 |
| March 21 | do | 6.35 | 1,139 | September 22 | do | 2.9 | 12 |
| April 30 | do | 4.6 | 923 | September 25 | do | 3.95 | 500 |
| May 2 | do | 4.7 | 568 | September 27 | do | 3.6 | 174 |
| May 24 | E. C. Murphy | 3.48 | 175 | September 30 | do | 4.0 | 464 |
| July 30 | W. A. Farish | 4.4 | 1,215 | October 2 | do | 3.3 | 96 |
| August 1 | R. L. Newman | 3.5 | 176 | October 4 | do | 3.3 | 87 |
| August 1 | do | 3.5 | 170 | October 6 | do | 3.3 | 79 |
| August 5 | do | 3.0 | 58 | October 8 | do | 3.2 | 29 |
| August 8 | do | 3.0 | 43 | October 11 | do | 3.0 | 15 |
| August 11 | do | 3.2 | 55 | October 13 | do | 3.0 | 22 |
| August 12 | do | 3.3 | 174 | October 16 | do | 3.0 | 27 |
| August 15 | do | 3.0 | 33 | October 18 | do | 3.1 | 25 |
| August 17 | do | 3.1 | 95 | October 20 | do | 3.0 | 20 |
| August 21 | do | 2.9 | 64 | October 23 | do | 3.1 | 25 |
| August 25 | do | 3.2 | 60 | October 25 | do | 3.0 | 18 |
| August 27 | do | 3.8 | 714 | October 27 | do | 3.0 | 20 |
| August 30 | do | 3.3 | 116 | October 30 | H. S. Reed | 3.0 | 11 |
| August 31 | do | 2.9 | 47 | November 1 | R. L. Newman | 3.0 | 11 |
| September 2 | do | 3.3 | 81 | November 8 | do | 4.3 | 624 |
| September 4 | do | 3.3 | 59 | November 9 | do | 4.25 | 412 |
| September 6 | do | 5.5 | 3,444 | November 13 | do | 3.3 | 49 |
| September 8 | do | 3.6 | 124 | November 18 | do | 3.1 | 40 |
| September 10 | do | 3.5 | 81 | November 22 | do | 3.7 | 225 |
| September 11 | do | 3.2 | 46 | November 24 | do | 4.0 | 112 |
| September 13 | do | 3.1 | 11 | November 29 | do | 3.9 | 479 |
| September 15 | do | 2.9 | 15 | | | | |

*Daily gage height, in feet, of Little Colorado River at Holbrook, Ariz., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 5.45 | 4.78 | 3.4 | 3.0 | 3.5 | 3.3 | 3.6 | 3.1 | 3.25 |
| 2 | ........ | 5.9 | 4.72 | 3.35 | 3.0 | 3.5 | 3.45 | 3.45 | 3.1 | 3.5 |
| 3 | ........ | 5.9 | 6.2 | 3.3 | 2.9 | 3.4 | 3.3 | 3.3 | 3.1 | 3.2 |
| 4 | ........ | 6.25 | ........ | 3.2 | 2.8 | 3.3 | 3.1 | 3.3 | 4.25 | 3.2 |
| 5 | ........ | 6.8 | ........ | 3.2 | 2.8 | 3.15 | 4.2 | 3.3 | 3.9 | 3.2 |
| 6 | ........ | 6.9 | ........ | 3.0 | 2.8 | 3.15 | 4.8 | 3.3 | 3.5 | 3.2 |
| 7 | ........ | 6.45 | ........ | 3.0 | 2.8 | 2.95 | 4.15 | 3.3 | 3.2 | 3.2 |
| 8 | ........ | 5.85 | ........ | 3.0 | 2.8 | 3.3 | 3.7 | 3.3 | 3.7 | 3.15 |
| 9 | ........ | 5.9 | ........ | 3.2 | 2.8 | 3.05 | 3.7 | 3.3 | 4.85 | 3.1 |
| 10 | ........ | 5.4 | 5.8 | 3.4 | 2.8 | 3.2 | 3.7 | 3.2 | 3.6 | 3.1 |
| 11 | ........ | 5.7 | 5.55 | 3.3 | 2.8 | 3.45 | 3.4 | 3.2 | 3.6 | 3.15 |
| 12 | ........ | 6.45 | 4.9 | 3.2 | 2.8 | 3.55 | 3.3 | 3.2 | 3.45 | 3.2 |
| 13 | ........ | 6.15 | 4.25 | 3.2 | 2.8 | 3.2 | 3.0 | 3.2 | 3.4 | 3.3 |
| 14 | ........ | 5.35 | 4.0 | 3.2 | 2.8 | 3.2 | 3.0 | 3.1 | 3.4 | 3.4 |
| 15 | ........ | 5.3 | 3.9 | 3.2 | 2.8 | 3.1 | 3.0 | 3.1 | 3.3 | 3.2 |
| 16 | ........ | 4.75 | 3.85 | 3.2 | 3.5 | 3.25 | 3.0 | 3.1 | 3.3 | 3.1 |
| 17 | 6.1 | 4.55 | 3.8 | 3.2 | 3.05 | 3.15 | 3.0 | 3.1 | 3.2 | 3.1 |
| 18 | 6.25 | 4.6 | 3.8 | 3.2 | 3.0 | 3.0 | 3.0 | 3.1 | 3.2 | 3.1 |
| 19 | 5.95 | 4.6 | 3.7 | 3.2 | 3.0 | 2.9 | 3.0 | 3.1 | 3.1 | 3.1 |
| 20 | 6.05 | 4.65 | 3.7 | 3.2 | 4.05 | 2.9 | 3.0 | 3.1 | 3.1 | 3.1 |
| 21 | 6.4 | 4.6 | 3.95 | 3.2 | 3.25 | 2.9 | 3.0 | 3.1 | 3.1 | 3.1 |
| 22 | 5.5 | 4.7 | 3.9 | 3.2 | 2.9 | 3.0 | 3.0 | 3.1 | 4.55 | 3.15 |
| 23 | 5.3 | 4.6 | 3.65 | 3.15 | 3.0 | 2.9 | 3.0 | 3.1 | 4.25 | 3.2 |
| 24 | 5.55 | 6.45 | 3.4 | 3.1 | 3.0 | 2.9 | 4.9 | 3.1 | 4.0 | 3.2 |
| 25 | 5.45 | 6.8 | 3.4 | 3.1 | 3.0 | 2.9 | 4.45 | 3.1 | 3.7 | 3.2 |
| 26 | 5.45 | 7.35 | 3.4 | 3.1 | 3.0 | 3.75 | 4.8 | 3.1 | 3.5 | 3.2 |
| 27 | 5.42 | 5.55 | 3.4 | 3.0 | 3.0 | 4.1 | 4.1 | 3.1 | 8.55 | 3.4 |
| 28 | 5.42 | 5.8 | 3.4 | 3.0 | 2.8 | 3.5 | 3.5 | 3.1 | 5.75 | 3.4 |
| 29 | 5.3 | 4.65 | 3.4 | 3.0 | 3.25 | 3.5 | 3.7 | 3.0 | 4.05 | 3.45 |
| 30 | 5.22 | 4.7 | 3.4 | 3.0 | 4.5 | 3.5 | 4.0 | 3.0 | 3.80 | 3.4 |
| 31 | 5.22 | ........ | 3.4 | ........ | 4.05 | 3.0 | ........ | 3.0 | ........ | 3.4 |

*Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 792 | 578 | 145 | 44 | 170 | 130 | 220 | 30 | 115 |
| 2 | ........ | 940 | 558 | 132 | 44 | 170 | 160 | 140 | 30 | 325 |
| 3 | ........ | 940 | 1,055 | 120 | 22 | 145 | 75 | 91 | 30 | 95 |
| 4 | ........ | 1,081 | ........ | 88 | 5 | 120 | 30 | 87 | 410 | 95 |
| 5 | ........ | 1,570 | ........ | 88 | 5 | 77 | 280 | 83 | 295 | 95 |
| 6 | ........ | 1,665 | ........ | 44 | 5 | 77 | 1,480 | 79 | 160 | 95 |
| 7 | ........ | 1,238 | ........ | 44 | 5 | 33 | 545 | 75 | 60 | 95 |
| 8 | ........ | 923 | ........ | 44 | 5 | 120 | 175 | 75 | 225 | 70 |
| 9 | ........ | 940 | ........ | 88 | 5 | 55 | 175 | 75 | 1,620 | 45 |
| 10 | ........ | 776 | 905 | 145 | 5 | 88 | 175 | 39 | 195 | 45 |
| 11 | ........ | 872 | 824 | 120 | 5 | 125 | 85 | 39 | 195 | 70 |
| 12 | ........ | 1,238 | 616 | 88 | 5 | 310 | 50 | 39 | 145 | 95 |
| 13 | ........ | 1,035 | 408 | 88 | 5 | 100 | 15 | 39 | 130 | 140 |
| 14 | ........ | 760 | 328 | 88 | 5 | 85 | 15 | 29 | 130 | 205 |
| 15 | ........ | 744 | 296 | 88 | 5 | 50 | 15 | 29 | 95 | 95 |
| 16 | ........ | 568 | 280 | 88 | 170 | 115 | 15 | 29 | 95 | 45 |

*Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1905*—Cont'd.

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 1,015 | 504 | 264 | 88 | 55 | 115 | 15 | 29 | 60 | 45 |
| 18 | 1,081 | 520 | 264 | 88 | 44 | 80 | 15 | 29 | 60 | 45 |
| 19 | 958 | 520 | 232 | 88 | 44 | 64 | 15 | 29 | 30 | 45 |
| 20 | 995 | 536 | 232 | 88 | 344 | 64 | 15 | 29 | 30 | 45 |
| 21 | 1,190 | 520 | 312 | 88 | 99 | 64 | 15 | 29 | 30 | 45 |
| 22 | 808 | 552 | 296 | 88 | 22 | 80 | 15 | 29 | 860 | 70 |
| 23 | 744 | 520 | 216 | 77 | 44 | 64 | 15 | 29 | 412 | 95 |
| 24 | 824 | 1,238 | 145 | 66 | 44 | 64 | 1,760 | 29 | 325 | 95 |
| 25 | 792 | 1,570 | 145 | 66 | 44 | 64 | 875 | 29 | 225 | 95 |
| 26 | 792 | 2,075 | 145 | 66 | 44 | 310 | 1,480 | 29 | 160 | 95 |
| 27 | 782 | 824 | 145 | 44 | 44 | 1,200 | 520 | 29 | 20,180 | 205 |
| 28 | 782 | 905 | 145 | 44 | 5 | 430 | 155 | 29 | 7,295 | 205 |
| 29 | 744 | 536 | 145 | 44 | 99 | 340 | 265 | 19 | 1,000 | 270 |
| 30 | 718 | 552 | 145 | 44 | 488 | 215 | 465 | 19 | 260 | 205 |
| 31 | 718 | ........ | 145 | ........ | 344 | 60 | ........ | 19 | ........ | 205 |

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly discharge of Little Colorado River at Holbrook, Ariz., for 1905.*

[Drainage area, 17,630 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 17–31 | 1,190 | 718 | 863 | 25,680 | 0.049 | 0.027 |
| April | 2,075 | 504 | 915 | 54,450 | .052 | .058 |
| May (25 days) | 1,055 | 145 | 353 | 17,500 | .020 | .019 |
| June | 145 | 44 | 82.6 | 4,915 | .0047 | .0052 |
| July | 488 | 5 | 67.9 | 4,175 | .0039 | .0045 |
| August | 1,200 | 33 | 163 | 10,020 | .0092 | .011 |
| September | 1,700 | 15 | 302 | 17,970 | .017 | .019 |
| October | 220 | 19 | 50.7 | 3,117 | .0029 | .0033 |
| November | 20,180 | 30 | 1,159 | 68,960 | .066 | .074 |
| December | 325 | 45 | 113 | 6,948 | .0064 | .0074 |
| The period | ........ | ........ | ........ | 213,700 | ........ | ........ |

*Summary of observations of evaporation at Holbrook, Ariz., in 1905.*

AUGUST.

| Day. | Period (in hours) in which measured evaporation has occurred. | Amount of evaporation. | Temperature of water in pan. | | | Temperature of water outside pan. | | |
|---|---|---|---|---|---|---|---|---|
| | | | A. M. | P. M. | Mean. | A. M. | P. M. | Mean. |
| 2 | 12 hours | 0.06 | | 72 | | | 72 | |
| 3 | 24 hours | .19 | 66 | 77 | 71.5 | 66 | 77 | 71.5 |
| 4 | do | .24 | 68 | 77 | 72.5 | 69 | 78 | 73.5 |
| 5 | do | .26 | 78 | 79 | 78.5 | 71 | 79 | [a] 75.0 |
| 6 | do | .27 | 71 | 80 | 75.5 | 71 | 80 | 75.5 |
| 7 | do | .29 | 72 | 78 | 75.0 | 72 | 79 | 75.5 |
| 8 | do | .23 | 74 | 78 | 76.0 | 73 | 78 | 75.5 |
| 9 | do | .26 | 71 | 72 | 71.5 | 70 | 72 | 71.0 |
| 10 | do | .29 | 70 | 75 | 72.5 | 70 | 75 | 72.5 |
| 11 | do | .12 | 68 | 77 | 72.5 | 69 | 77 | [b] 73.0 |
| 12 | do | .24 | 69 | 78 | 73.5 | 70 | 78 | 74.0 |
| 13 | do | .25 | 69 | 76 | 72.5 | 70 | 76 | 73.0 |
| 14 | do | .29 | 69 | 77 | 73.0 | 69 | 77 | 73.0 |
| 15 | do | .24 | 70 | 77 | 73.5 | 71 | 77 | 74.0 |
| 16 | do | .23 | 70 | 78 | 74.0 | 70 | 77 | 73.5 |
| 17 | do | .19 | 70 | 78 | 74.0 | 71 | 78 | 74.5 |
| 18 | do | .26 | 70 | 78 | 74.0 | 71 | 77 | 74.0 |
| 19 | do | .21 | 69 | 77 | 73.0 | 70 | 78 | 74.0 |
| 20 | do | .24 | 70 | 76 | 73.0 | 70 | 77 | 73.5 |
| 21 | do | .23 | 69 | 76 | 72.5 | 70 | 77 | 73.5 |
| 22 | do | .31 | 70 | 74 | 72.0 | 71 | 75 | [c] 73.0 |
| 23 | do | .10 | 70 | 75 | 72.5 | 71 | 75 | 73.0 |
| 24 | do | .20 | 70 | 75 | 72.5 | 71 | 75 | [b] 73.0 |
| 25 | do | .09 | 70 | 76 | 73.0 | 70 | 75 | 72.5 |
| 26 | do | .21 | 71 | 78 | 74.5 | 71 | 78 | 74.5 |
| 27 | do | .19 | 71 | 71 | 71.0 | 71 | 71 | 71.0 |
| 28 | do | .22 | 70 | 78 | 74.0 | 71 | 77 | 74.0 |
| 29 | do | .16 | 71 | 81 | 76.0 | 71 | 80 | 75.5 |
| 30 | do | .23 | 72 | 76 | 74.0 | 72 | 76 | 74.0 |
| 31 | do | .30 | 72 | 76 | 74.0 | 72 | 76 | 74.0 |

[a] Slight wind. [b] Rain. [c] High wind.

*Summary of observations of evaporation at Holbrook, Ariz., in 1905*—Continued.

SEPTEMBER.

| Day. | Period (in hours) in which measured evaporation has occurred. | Amount of evaporation. | Temperature of water in pan. | | | Temperature of water outside pan. | | |
|---|---|---|---|---|---|---|---|---|
| | | | A. M. | P. M. | Mean. | A. M. | P. M. | Mean. |
| 1 | 24 hours | 0.19 | 69 | 76 | 72.5 | 70 | 76 | 73.0 |
| 2 | do | .24 | 79 | 78 | 78.5 | 70 | 78 | 74.0 |
| 3 | do | .26 | 69 | 71 | 70.0 | 69 | 71 | 70.0 |
| 4 | do | .06 | 69 | 70 | 69.5 | 68 | 70 | 69.0 |
| 5 | do | .09 | 66 | 66 | 66.0 | 67 | 66 | 66.5 |
| 6 | do | .11 | 64 | 70 | 67.0 | 65 | 70 | 67.5 |
| 7 | do | .14 | 64 | 73 | 68.5 | 65 | 72 | 68.5 |
| 8 | do | .18 | 65 | 71 | 68.0 | 65 | 71 | 68.0 |
| 9 | do | .18 | 65 | 73 | 69.0 | 65 | 73 | 69.0 |
| 10 | do | .17 | 64 | 72 | 68.0 | 65 | 70 | 67.5 |
| 11 | do | .16 | 62 | 73 | 67.5 | 63 | 72 | 67.5 |
| 12 | do | .22 | 65 | 71 | 68.0 | 65 | 71 | 68.0 |
| 13 | do | .21 | 65 | 72 | 68.5 | 66 | 72 | 69.0 |
| 14 | do | .21 | 66 | 72 | 69.0 | 66 | 72 | 69.0 |
| 15 | do | .21 | 61 | 73 | 67.0 | 61 | 73 | 67.0 |
| 16 | do | .27 | 65 | 72 | 68.5 | 65 | 72 | [a] 68.5 |
| 17 | do | .22 | 63 | 70 | 66.5 | 63 | 70 | [a] 66.5 |
| 18 | do | .20 | 65 | 68 | 66.5 | 65 | 68 | 66.5 |
| 19 | do | .20 | 59 | 70 | 64.5 | 60 | 70 | 65.0 |
| 20 | do | .18 | 60 | 69 | 64.5 | 61 | 70 | 65.5 |
| 21 | do | .17 | 60 | 70 | 65.0 | 61 | 71 | 66.0 |
| 22 | do | .16 | 61 | 71 | 66.0 | 62 | 71 | 66.5 |
| 23 | do | .06 | 62 | 62 | 62.0 | 62 | 62 | 62.0 |
| 24 | do | .0 | 61 | 65 | 63.0 | 61 | 65 | 63.0 |
| 25 | do | .0 | 60 | 60 | 60.0 | 60 | 60 | 60.0 |
| 26 | do | .10 | 61 | 61 | 61.0 | 62 | 61 | 61.5 |
| 27 | do | .14 | 65 | 72 | 68.5 | 64 | 71 | 67.5 |
| 28 | do | .09 | 63 | 61 | 62.0 | 63 | 61 | 62.0 |
| 29 | do | .05 | 61 | 59 | 60.0 | 63 | 60 | 61.5 |
| 30 | do | .10 | 55 | 61 | 58.0 | 56 | 62 | 59.0 |

[a] High wind.

*Summary of observations of evaporation at Holbrook, Ariz., in 1905*—Continued.

OCTOBER.

| Day. | Period (in hours) in which measured evaporation has occurred. | Amount of evaporation. | Temperature of water in pan. | | | Temperature of water outside pan. | | |
|---|---|---|---|---|---|---|---|---|
| | | | A. M. | P. M. | Mean. | A. M. | P. M. | Mean. |
| 1.... | 24 hours | 0.08 | 55 | 67 | 61.0 | 56 | 66 | 61.0 |
| 2.... | .....do | .14 | 56 | 68 | 62.0 | 57 | 68 | 62.5 |
| 3.... | .....do | .12 | 59 | 67 | 63.0 | 59 | 67 | 63.0 |
| 4.... | .....do | .11 | 57 | 69 | 63.0 | 57 | 69 | 63.0 |
| 5.... | .....do | .12 | 59 | 70 | 64.5 | 60 | 69 | 64.5 |
| 6.... | .....do | .11 | 60 | 70 | 65.0 | 60 | 70 | 65.0 |
| 7.... | .....do | .15 | 59 | 73 | 66.0 | 61 | 73 | 67.0 |
| 8.... | .....do | .26 | 61 | 65 | 63.0 | 60 | 64 | [a] 62.0 |
| 9.... | .....do | .16 | 58 | 64 | 61.0 | 58 | 64 | 61.0 |
| 10.... | .....do | .16 | 58 | 65 | 61.5 | 58 | 64 | 61.0 |
| 11.... | .....do | .17 | 58 | 67 | 62.5 | 58 | 67 | 62.5 |
| 12.... | .....do | .08 | 55 | 62 | 58.5 | 55 | 60 | 57.5 |
| 13.... | .....do | .14 | 56 | 58 | 57.0 | 56 | 58 | 57.0 |
| 14.... | .....do | .14 | 55 | 60 | 57.5 | 54 | 60 | 57.0 |
| 15.... | .....do | .18 | 55 | 64 | 59.5 | 54 | 64 | 59.0 |
| 16.... | .....do | .20 | 52 | 57 | 54.5 | 51 | 56 | 53.5 |
| 17.... | .....do | .19 | 50 | 55 | 52.5 | 50 | 54 | 52.0 |
| 18.... | .....do | .18 | 49 | 53 | 51.0 | 49 | 54 | 51.5 |
| 19.... | .....do | .14 | 50 | 56 | 53.0 | 49 | 56 | 52.5 |
| 20.... | .....do | .10 | 42 | 49 | 45.5 | 42 | 48 | 45.0 |
| 21.... | .....do | .08 | 42 | 62 | 52.0 | 49 | 59 | 54.0 |
| 22.... | .....do | .13 | 57 | 64 | 60.5 | 56 | 63 | 59.5 |
| 23.... | .....do | .09 | 52 | 57 | 54.5 | 52 | 56 | 54.0 |
| 24.... | .....do | .11 | 52 | 58 | 55.0 | 51 | 57 | 54.0 |
| 25.... | .....do | .14 | 50 | 59 | 54.5 | 51 | 58 | 54.5 |
| 26.... | .....do | .08 | 51 | 54 | 52.5 | 51 | 55 | 53.0 |
| 27.... | .....do | .10 | 48 | 53 | 50.5 | 49 | 52 | 50.5 |
| 28.... | .....do | .11 | 48 | 52 | 50.0 | 50 | 52 | 51.0 |
| 29.... | .....do | .16 | 49 | 59 | 54.0 | 50 | 57 | 53.5 |
| 30.... | .....do | .17 | 42 | 60 | 51.0 | 43 | 59 | 51.0 |
| 31.... | .....do | .16 | 41 | 56 | 48.5 | 42 | 57 | 49.5 |

[a] High wind.

*Summary of observations of evaporation at Holbrook, Ariz., in 1905*—Continued.

NOVEMBER.

| Day. | Period (in hours) in which measured evaporation has occurred. | Amount of evaporation. | Temperature of water in pan. | | | Temperature of water outside pan. | | |
|---|---|---|---|---|---|---|---|---|
| | | | A. M. | P. M. | Mean. | A. M. | P. M. | Mean. |
| 1 | 24 hours | 0.07 | 42 | 52 | 47.0 | 43 | 51 | 47.0 |
| 2 | do | .00 | 43 | 59 | 51.0 | 42 | 57 | 49.5 |
| 3 | do | .06 | 50 | 54 | 52.0 | 50 | 54 | 52.0 |
| 4 | do | .04 | 51 | 59 | 55.0 | 51 | 59 | 55.0 |
| 5 | do | .02 | 50 | 54 | 52.0 | 50 | 53 | 51.5 |
| 6 | do | .03 | 52 | 50 | 51.0 | 52 | 50 | 51.0 |
| 7 | do | .07 | 50 | 55 | 52.5 | 50 | 55 | 52.5 |
| 8 | do | | 51 | 47 | 49.0 | 51 | 48 | 49.5 |
| 9 | do | .08 | 47 | 52 | 49.5 | 47 | 52 | 49.5 |
| 10 | do | .07 | 45 | 48 | 46.5 | 46 | 48 | 47.0 |
| 11 | do | .08 | 45 | 50 | 47.5 | 45 | 50 | 47.5 |
| 12 | do | .10 | 47 | 52 | 49.5 | 47 | 52 | 49.5 |
| 13 | do | .04 | 43 | 54 | 48.5 | 44 | 54 | 49.0 |
| 14 | do | .06 | 52 | 51 | 51.5 | 52 | 51 | 51.5 |
| 15 | do | .08 | 43 | 52 | 47.5 | 44 | 52 | 48.0 |
| 16 | do | .06 | 47 | 50 | 48.5 | 47 | 50 | 48.5 |
| 17 | do | .07 | 45 | 51 | 48.0 | 46 | 51 | 48.5 |
| 18 | do | .06 | 40 | 52 | 46.0 | 41 | 52 | 46.5 |
| 19 | do | .06 | 43 | 52 | 47.5 | 45 | 50 | 47.5 |
| 20 | do | .08 | 49 | 50 | 49.5 | 49.5 | 50 | 49.5 |
| 21 | do | .05 | 44 | 50 | 47.0 | 45 | 50 | 47.5 |
| 22 | do | .00 | 45 | 48 | 46.5 | 45 | 48 | 46.5 |
| 23 | do | .02 | 45 | 48 | 46.5 | 45 | 48 | 46.5 |
| 24 | do | .07 | 45 | 48 | 46.5 | 45 | 48 | 46.5 |
| 25 | do | .05 | 45 | 49 | 47.0 | 45 | 49 | 47.0 |
| 26 | do | .00 | 50 | 49 | 49.5 | 50 | 48 | 49.0 |
| 27 | do | .00 | 45 | 48 | 46.5 | 45 | 48 | 46.5 |
| 28 | do | .10 | 40 | 49 | 44.5 | 42 | 49 | [a] 45.5 |
| 29 | do | .00 | 41 | 49 | 45.0 | 41 | 49 | 45.0 |
| 30 | do | .03 | 40 | 45 | 42.5 | 40 | 45 | 42.5 |

[a] High wind.

*Summary of observations of evaporation at Holbrook, Ariz., in 1905*—Continued.

DECEMBER.

| Day. | Period (in hours) in which measured evaporation has occurred. | Amount of evaporation. | Temperature of water in pan. | | | Temperature of water outside pan. | | |
|---|---|---|---|---|---|---|---|---|
| | | | A. M. | P. M. | Mean. | A. M. | P. M. | Mean. |
| 1 | 24 hours | 0.08 | 38 | 48 | 43.0 | 41 | 48 | 44.5 |
| 2 | do | .00 | 38 | 42 | 40.0 | 40 | 42 | 41.0 |
| 3 | do | .05 | 40 | 45 | 42.5 | 40 | 42 | 41.0 |
| 4 | do | .00 | 40 | 45 | 42.5 | 40 | 45 | 42.5 |
| 5 | do | .04 | 40 | 45 | 42.5 | 40 | 45 | 42.5 |
| 6 | do | .00 | 40 | 45 | 42.5 | 40 | 45 | 42.5 |
| 7 | do | .04 | 40 | 48 | 44.0 | 40 | 48 | 44.0 |
| 8 | do | .00 | 40 | 43 | 41.5 | 40 | 43 | 41.5 |
| 9 | do | .00 | 40 | 42 | 41.0 | 40 | 42 | 41.0 |
| 10 | do | .00 | 40 | 41 | 40.5 | 40 | 41 | 40.5 |
| 11 | do | .00 | 35 | 38 | 36.5 | 34 | 38 | 36.0 |
| 12 | do | .00 | 40 | 42 | 41 | 40 | 42 | 41.0 |
| 13 | do | .00 | 40 | 42 | 41.0 | 40 | 42 | 41.0 |
| 14 | do | .00 | 38 | 41 | 39.5 | 34 | 40 | 37.0 |
| 15 | do | .00 | 40 | 43 | 41.5 | 40 | 43 | 41.5 |
| 16 | do | .00 | 39 | 41 | 40.0 | 40 | 41 | 40.5 |
| 17 | do | .00 | 39 | 40 | 39.5 | 40 | 41 | 40.5 |
| 18 | do | .00 | 37 | 39 | 38.0 | 39 | 40 | 39.5 |
| 19 | do | .00 | 37 | 39 | 38.0 | 39 | 40 | 39.5 |
| 20 | do | .01 | 35 | 40 | 37.5 | 37 | 40 | 38.5 |
| 21 | do | .00 | 35 | 40 | 37.5 | 36 | 40 | 38.0 |
| 22 | do | .00 | 33 | 38 | 35.5 | 34 | 39 | 36.5 |
| 23 | do | .00 | 32 | 34 | 33.0 | 32 | 34 | 33.0 |

## CHEVLON FORK NEAR WINSLOW, ARIZ.

This station was established December 18, 1905. It is located 4½ miles above the mouth of the river, in sec. 34, T. 18 N., R. 17 E., 19 miles east of Winslow, Ariz.

The channel is straight for 150 feet above and below the station. The current is very swift during high water. At extreme low water the current is rather sluggish, but it has a good velocity at ordinary stage. Both banks are practically vertical cliffs about 33 feet high. A dirt bank extending about 12 feet from the base of the cliff and 3 or 4 feet high has been deposited at the foot of the cliff on the left bank. The bed is of solid rock excepting a small bank of sand on the left bank which is alternately deposited and scoured out.

Discharge measurements are made by means of a cable, car, and tagged and stay wires The initial point for soundings is the face of the eyebolt to which the tagged wire is fastened on the left bank of the stream. A secondary cable has been stretched across the river 100 feet downstream from the tagged wire for use in making float measurements at very high stages.

An automatic water stage register is placed on an overhanging platform 26.5 feet above the bed of the creek. The station is visited and the register reset once each week by R. L. Newman. The distance to the center of the first band from the top of the baseboard upon which the register sets is 5.90 feet; to the center of the second band, from the same point, 9.57 feet. The base of the register baseboard is 27.30 feet above the datum of the gage.

*Discharge measurements of Chevlon Fork near Winslow, Ariz., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| November 25.. | H. S. Reed | 5.0 | 1.36 | 0.65 | 1.00 | 0.88 |
| December 19... | .....do | 42.0 | 104 | .32 | 2.10 | 33.3 |

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in the Little Colorado River drainage basin during 1905:

*Miscellaneous discharge measurements made in Little Colorado River drainage basin in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| August 19...... | Chevlon Fork... | Crossing of Holbrook-Winslow wagon road. | 26.7 | 8.2 | 1.10 | .......... | 9.1 |
| August 19...... | .....do.......... | .....do............ | 26.7 | 7.9 | 1.39 | 0.5 | 11.1 |
| August 30...... | .....do.......... | .....do............ | 25.5 | 13.7 | .92 | .7 | 12.6 |
| September 10... | .....do.......... | .....do............ | 23.6 | 9.9 | .65 | .4 | 6.4 |
| September 19... | .....do.......... | .....do............ | 26.0 | 7.0 | .65 | .5 | 4.5 |
| September 29... | .....do.......... | .....do............ | 24.0 | 12.7 | 1.34 | .7 | 17.0 |
| October 9...... | .....do.......... | .....do............ | 19.7 | 9.0 | 1.03 | .5 | 9.3 |
| October 18..... | .....do.......... | .....do............ | 20.1 | 9.1 | 1.16 | .5 | 10.6 |

# VIRGIN RIVER DRAINAGE BASIN.

## MUDDY RIVER NEAR MOAPA, NEV.

Muddy River is a branch of the Virgin, one of the more important tributaries of the Colorado. The stream drains a long narrow strip of country in the eastern part of Lincoln County, Nev., flows southward, and joins the Virgin about 25 miles above the point where the latter stream enters the Colorado.

The gaging station was established January 1, 1904. It is located near the crossing of the San Pedro, Los Angeles and Salt Lake Railroad, about 6 miles downstream from Moapa, Nev. The station is above the Narrows and will show the amount of water available for storage at the proposed reservoir site in the Narrows.

The channel is straight for 35 feet above and below the station, and high, brush-covered banks slope up from the vertical sides of the channel. The immediate banks are low, but not liable to overflow. The bed of the stream is composed of sand and is shifting. It is covered with vegetation, which is kept grubbed out near the station. The current has a moderate velocity.

Discharge measurements are made from a footbridge 450 feet downstream from the gage. The initial point for soundings is a nail driven into the downstream side of the bridge at the right bank.

The gage, which was read twice each day during 1905 by J. V. Houghton, is a vertical staff nailed to a post driven into the right bank. The bench mark is the top of a 2-inch post driven into the ground in a willow clump 20 feet from the gage on the right bank; elevation, 9.90 feet above the zero of the gage.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 196–197.

*Daily gage height, in feet, of Muddy River near Moapa, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.2 | 3.6 | 2.0 | 2.0 | 2.1 | 1.9 | 1.9 | 2.0 | 1.9 | 2.2 | 2.3 | 2.5 |
| 2 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 1.9 | 1.9 | 2.0 | 2.0 | 2.2 | 2.4 | 2.5 |
| 3 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 1.9 | 1.9 | 2.0 | 1.9 | 2.2 | 2.4 | 2.6 |
| 4 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 1.9 | 1.9 | 1.9 | 1.95 | 2.2 | 2.4 | 2.6 |
| 5 | 2.2 | 3.6 | 2.0 | 2.2 | 1.9 | 2.0 | 1.9 | 1.9 | 1.9 | 2.2 | 2.4 | 2.6 |
| 6 | 2.2 | 3.6 | 2.0 | 2.2 | 1.9 | 2.0 | 1.9 | 1.9 | 1.9 | 2.2 | 2.4 | 2.7 |
| 7 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 2.0 | 2.4 | 2.7 |
| 8 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 2.0 | 1.9 | 2.0 | 1.9 | 2.0 | 2.4 | 2.7 |
| 9 | 2.2 | 3.6 | 2.0 | 2.2 | 2.0 | 2.0 | 1.9 | 2.0 | 2.0 | 2.0 | 2.4 | 2.7 |
| 10 | 2.2 | 3.4 | 2.0 | 2.3 | 2.0 | 2.0 | 1.9 | 6.5 | 1.9 | 2.0 | 2.4 | 2.8 |
| 11 | 2.3 | 3.4 | 2.0 | 3.6 | 2.0 | 1.9 | 1.9 | 5.8 | 1.8 | 2.0 | 2.4 | 2.85 |
| 12 | 2.3 | 3.3 | 3.0 | 3.8 | 2.0 | 1.9 | 1.9 | 2.5 | 1.8 | 2.0 | 2.4 | 2.8 |
| 13 | 2.3 | 3.3 | 3.5 | 3.4 | 2.0 | 1.9 | 1.9 | 2.0 | 1.8 | 1.0 | 2.4 | 2.7 |
| 14 | 2.3 | 2.7 | 4.0 | 3.4 | 2.0 | 1.9 | 1.7 | 2.0 | 1.9 | 1.9 | 2.5 | 2.7 |
| 15 | 2.3 | 2.7 | 4.2 | 3.2 | 2.0 | 1.9 | 1.5 | 2.0 | 2.0 | 1.9 | 2.5 | 2.7 |
| 16 | 2.3 | 2.6 | 4.4 | 3.2 | 1.9 | 1.9 | 1.2 | 2.0 | 2.0 | 1.9 | 2.4 | 2.7 |
| 17 | 2.3 | 2.5 | 4.4 | 2.6 | 1.9 | 1.9 | 3.6 | 2.0 | 2.0 | 1.9 | 2.4 | 2.7 |
| 18 | 2.5 | 2.5 | 4.2 | 2.4 | 1.9 | 1.9 | 3.5 | 2.0 | 2.0 | 2.0 | 2.4 | 2.7 |
| 19 | 2.5 | 2.4 | 4.0 | 2.2 | 1.9 | 1.9 | 3.4 | 2.0 | 2.0 | 2.15 | 2.5 | 2.6 |
| 20 | 2.45 | 2.3 | 3.5 | 2.1 | 1.9 | 1.9 | 3.0 | 2.0 | 2.0 | 2.2 | 2.5 | 2.6 |
| 21 | 2.45 | 2.3 | 3.5 | 2.1 | 1.8 | 1.9 | 3.0 | 1.9 | 1.9 | 2.2 | 2.5 | 2.6 |
| 22 | 2.45 | 2.2 | 3.0 | 2.1 | 1.8 | 1.9 | 3.0 | 1.9 | 1.9 | 2.2 | 2.5 | 2.6 |
| 23 | 2.45 | 2.2 | 2.2 | 2.1 | 1.8 | 1.9 | 2.5 | 1.9 | 1.9 | 2.25 | 2.5 | 2.6 |
| 24 | 2.45 | 2.1 | 2.2 | 2.15 | 1.8 | 1.9 | 2.3 | 1.9 | 2.0 | 2.3 | 2.5 | 2.6 |
| 25 | 2.45 | 2.0 | 2.2 | 2.1 | 1.8 | 1.9 | 2.3 | 2.0 | 2.0 | 2.3 | 2.5 | 2.6 |
| 26 | 2.45 | 2.0 | 2.1 | 2.1 | 1.8 | 1.9 | 2.0 | 2.0 | 2.0 | 2.3 | 2.5 | 2.6 |
| 27 | 2.45 | 2.0 | 2.0 | 2.1 | 1.8 | 1.9 | 2.0 | 2.0 | 2.0 | 2.3 | 2.6 | 2.7 |
| 28 | 2.45 | 2.0 | 2.0 | 2.1 | 1.8 | 1.9 | 2.0 | 2.0 | 2.0 | 2.3 | 2.6 | 2.7 |
| 29 | 2.45 | ....... | 2.0 | 2.1 | 1.8 | 1.9 | 1.9 | 1.90 | 2.6 | 2.3 | 2.6 | 2.7 |
| 30 | 2.45 | ....... | 2.0 | 2.1 | 1.8 | 1.9 | 1.9 | 1.90 | 2.15 | 2.3 | 2.5 | 2.7 |
| 31 | 3.8 | ....... | 2.0 | ....... | 1.8 | ....... | 1.9 | 1.90 | ....... | 2.3 | ....... | 2.7 |

## GILA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Gila River rises in western and southwestern New Mexico, receiving its waters from mountains having an elevation of from 7,000 to 8,000 feet. At the point where it crosses into Arizona it still has an elevation of 6,000 feet. From this place it flows between mountain ranges, falling rapidly, until at Florence, 180 miles away, it is about 1,500 feet above sea level. At a point about 15 miles above Florence the river emerges upon the plains, through which it winds for about 75 miles before receiving the waters of its principal tributary, the Salt. From the junction of the Salt the Gila continues west and southwest and enters the Colorado at Yuma, Ariz., near the southwestern corner of the Territory.

The principal tributaries are the San Pedro and Santa Cruz rivers from the south, and the San Francisco, Salt, Aqua Fria, and Hassayampa rivers from the north.

San Francisco River rises in the southwestern part of Socorro County, N. Mex., and flows southwestward into Graham County, Ariz., where it unites with the Gila. The basin comprises approximately 1,800 square miles of high, mountainous country.

Salt River, though considered a tributary of the Gila, is in fact larger both in catchment area and in discharge. It receives the drainage from central Arizona, its principal tributary, the Verde, flowing southeasterly and south from the mountains and table-lands south of the Colorado River. The Verde Valley is situated in Yavapai County, Ariz., on the headwaters of the stream, and extends from a canyon above Camp Verde to a point about 10 miles below the fort. About a mile above the junction of the Verde and 30 miles above Phoenix the Salt enters upon the plains of the Gila Valley.

San Pedro River rises in the northern part of the Mexican State of Sonora, flows northward for more than 100 miles, and empties into the Gila a few miles below the town of Dudleyville, 45 miles above Florence, Ariz. Rising in a country of very light snowfall, the river depends for the greater part of its water supply on the frequent showers of the rainy seasons. It flows over a sandy bed between high, steep banks, and during the dry season it shrinks to an insignificant stream of clear water which rises and sinks in the sand with the varying depth of bed rock.

The floods of the upper Gila and its tributaries are usually short and violent, occurring during the months of January and February. The season of low water occurs in June and July.

## GILA RIVER NEAR CLIFF, N. MEX.

This station was established September 9, 1904. It is located 9 miles below Cliff post-office and one-half mile below the mouth of Mangos River. It is 40 miles from Silver City, N. Mex. The station is best reached by stage from Silver City to Gila Store, thence by private conveyance. If the river is in flood, the latter part of the journey must be made on horseback.

The channel is straight for 400 feet above and 300 feet below the station. The banks are about 6 feet high, are clean, and are subject to overflow during extreme high water. The bed of the stream is composed of sand and gravel, is free from vegetation, and is shifting. There is but one channel at all stages. At low water the channel, although straight, cuts across the section at a slight angle; during freshets the channel will be at right angles to the measuring section.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage is read twice each day by Mrs. Winnie P. Clark. The original gage was a staff fastened to a large cottonwood tree on the east side of the river. This gage was carried out by heavy freshets in the early part of 1905, but observations of gage heights were continued on a temporary gage until February 17, 1905, when the station was temporarily abandoned. On May 22, 1905, the gage was reestablished and the station put in order, and observations of gage heights were again begun. The bench mark is a point marked "U.S.G.S. B.M." with black paint in a blaze on a sycamore tree N. 84° E. 293 feet from the gage; elevation, 8.55 feet above the zero of the gage.

A description of this station, with gage-height data, is contained in Water-Supply Paper No. 133, United States Geological Survey, page 198.

*Discharge measurements of Gila River, near Cliff, N. Mex., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft* |
| June 14 | F. Asplind | 3.15 | 358 | September 20 | F. Asplind | 2.70 | 70 |
| June 14[a] | do | 3.15 | 337 | September 21 | do | 2.65 | 61 |
| July 7 | do | 2.10 | 85 | September 22 | do | 2.75 | 80 |
| July 8 | do | 2.05 | 73 | September 23 | do | 2.75 | 82 |
| July 9[a] | do | 2.05 | 82 | September 24[a] | do | 10.20 | 5,528 |
| July 9[a] | do | 2.05 | 73 | September 25 | do | 3.85 | 276 |
| July 24 | do | 2.50 | 153 | September 25 | do | 3.65 | 222 |
| July 25 | do | 2.38 | 126 | September 26 | do | 3.65 | 220 |
| July 26 | do | 2.25 | 110 | September 27 | do | 3.55 | 201 |
| July 26[a] | do | 4.05 | 602 | September 28 | do | 3.65 | 225 |
| July 27 | do | 2.65 | 192 | October 26 | do | 3.10 | 118 |
| July 27 | do | 2.58 | 173 | October 27 | do | 3.10 | 118 |
| July 27 | do | 2.45 | 144 | October 28 | do | 3.10 | 121 |
| July 28 | do | 2.60 | 178 | October 29 | do | 3.10 | 119 |
| July 28 | do | 2.40 | 131 | October 30 | do | 3.10 | 122 |
| July 29 | do | 3.30 | 338 | October 31 | do | 3.10 | 121 |
| August 18 | do | 2.90 | 184 | November 1 | do | 3.10 | 120 |
| August 19 | do | 2.72 | 106 | November 2 | do | 3.15 | 134 |
| August 20 | do | 2.70 | 95 | November 4 | do | 3.35 | 168 |
| August 21 | do | 2.70 | 93 | November 5 | do | 3.35 | 168 |
| August 22 | do | 2.80 | 120 | November 21 | do | 3.25 | 154 |
| August 23 | do | 2.65 | 96 | November 22 | do | 3.98 | 316 |
| August 24 | do | 2.65 | 74 | November 23[a] | do | 5.85 | 1,091 |
| August 25 | do | 2.65 | 74 | November 23 | do | 6.00 | 1,210 |
| August 26 | do | 2.80 | 121 | November 24 | do | 5.15 | 714 |
| August 27 | do | 2.75 | 111 | November 25 | do | 4.60 | 485 |
| September 19 | do | 2.70 | 71 | November 26 | do | 4.45 | 427 |

[a] Float measurement.

*Daily gage height, in feet, of Gila River, near Cliff, N. Mex., for 1905.*

| Day. | Jan. | Feb. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .95 | 1.05 | | 3.45 | 2.18 | 2.9 | 2.82 | 3.85 | 3.1 | 6.45 |
| 2 | .9 | 1.05 | | 3.42 | 2.18 | 2.85 | 4.4 | 3.7 | 3.12 | 5.98 |
| 3 | .9 | 1.67 | | 3.48 | 2.18 | 2.8 | 3.8 | 3.62 | 3.12 | 5.55 |
| 4 | .9 | 3.97 | | 3.5 | 2.18 | 2.9 | 3.6 | 3.52 | 3.22 | 5.38 |
| 5 | .9 | 4.07 | | 3.5 | 2.18 | 3.25 | 3.9 | 3.42 | 3.35 | 5.15 |
| 6 | .9 | 4.02 | | 3.35 | 2.12 | 2.9 | 3.75 | 3.4 | 3.35 | 5.0 |
| 7 | .9 | 3.4 | | 3.3 | 2.1 | 2.9 | 3.52 | 3.3 | 3.4 | 4.88 |
| 8 | .9 | 2.9 | | 3.37 | 2.08 | 3.55 | 3.5 | 3.28 | 4.17 | 4.75 |
| 9 | .93 | 2.72 | | 3.62 | 2.05 | 3.1 | 3.85 | 3.22 | 4.12 | 4.62 |
| 10 | | 2.65 | | 3.55 | 2.05 | 3.48 | 3.65 | 3.2 | 4.05 | 4.6 |
| 11 | | 2.6 | | 3.35 | 2.08 | 3.5 | 3.5 | 3.18 | 3.85 | 4.6 |
| 12 | | 2.5 | | 3.25 | 2.1 | 3.4 | 3.32 | 3.15 | 3.72 | 4.6 |
| 13 | | 2.3 | | 3.18 | 2.18 | 3.15 | 3.22 | 3.15 | 3.6 | 4.55 |
| 14 | | 2.15 | | 3.12 | 2.18 | 3.07 | 3.2 | 3.12 | 3.65 | 4.5 |
| 15 | | 2.12 | | 3.02 | 2.18 | 3.02 | 3.1 | 3.1 | 3.5 | 4.5 |
| 16 | | 2.8 | | 2.97 | 2.15 | 2.95 | 2.95 | 3.1 | 3.42 | 4.45 |
| 17 | | 6.15 | | 2.9 | 2.12 | 2.9 | 2.9 | 3.1 | 3.4 | 4.4 |
| 18 | | | | 2.85 | 2.18 | 2.95 | 2.82 | 3.1 | 3.35 | 4.4 |
| 19 | | | | 2.78 | 2.22 | 2.75 | 2.72 | 3.12 | 3.3 | 4.7 |

*Daily gage height, in feet, of Gila River, near Cliff, N. Mex., for 1905*—Continued.

| Day. | Jan. | Feb. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1.2 | ........ | ........ | 2.7 | 2.28 | 2.7 | 2.7 | 3.1 | 3.2 | 4.52 |
| 21 | 1.1 | ........ | ........ | 2.65 | 2.35 | 2.7 | 2.68 | 3.1 | 3.22 | 4.48 |
| 22 | 1.1 | ........ | 4.2 | 2.52 | 2.3 | 2.8 | 2.72 | 3.1 | 3.95 | 4.42 |
| 23 | 1.09 | ........ | 4.05 | 2.45 | 2.3 | 2.67 | 2.75 | 3.08 | 5.8 | 4.35 |
| 24 | 1.09 | ........ | 4.0 | 2.38 | 2.32 | 2.67 | 4.88 | 3.08 | 5.1 | 4.22 |
| 25 | 1.1 | ........ | 3.92 | 2.38 | 2.32 | 2.67 | 3.78 | 3.1 | 4.6 | 4.15 |
| 26 | 1.1 | ........ | 3.85 | 2.28 | 3.37 | 2.85 | 3.58 | 3.1 | 4.42 | 4.15 |
| 27 | 1.1 | ........ | 3.72 | 2.28 | 2.55 | 2.72 | 3.55 | 3.1 | 11.9 | 4.15 |
| 28 | 1.1 | ........ | 3.68 | 2.25 | 2.6 | 2.65 | 3.6 | 3.1 | 9.9 | 4.18 |
| 29 | 1.1 | ........ | 3.62 | 2.25 | 3.28 | 2.65 | 3.48 | 3.1 | 8.25 | 4.2 |
| 30 | 1.1 | ........ | 3.52 | 2.22 | 3.55 | 2.62 | 3.9 | 3.1 | 7.1 | 4.2 |
| 31 | 1.1 | ........ | 3.4 | ........ | 2.95 | 2.7 | ........ | 3.1 | ........ | 4.2 |

*Daily discharge, in second-feet, of Gila River, near Cliff, N. Mex., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 405 | 93 | 105 | 87 | 268 | 127 | 3,190 |
| 2 | ........ | 396 | 93 | 150 | 411 | 235 | 130 | 2,387 |
| 3 | ........ | 414 | 93 | 130 | 255 | 219 | 130 | 1,570 |
| 4 | ........ | 420 | 93 | 165 | 215 | 219 | 147 | 1,247 |
| 5 | ........ | 420 | 93 | 270 | 280 | 183 | 170 | 810 |
| 6 | ........ | 375 | 83 | 165 | 245 | 179 | 170 | 655 |
| 7 | ........ | 360 | 80 | 165 | 199 | 161 | 179 | 532 |
| 8 | ........ | 381 | 77 | 436 | 195 | 158 | 348 | 530 |
| 9 | ........ | 458 | 72 | 250 | 267 | 147 | 335 | 498 |
| 10 | ........ | 436 | 72 | 418 | 225 | 144 | 317 | 490 |
| 11 | ........ | 375 | 77 | 420 | 195 | 141 | 268 | 490 |
| 12 | ........ | 346 | 80 | 385 | 165 | 136 | 239 | 490 |
| 13 | ........ | 326 | 93 | 270 | 147 | 136 | 215 | 470 |
| 14 | ........ | 310 | 93 | 235 | 144 | 130 | 225 | 450 |
| 15 | ........ | 282 | 93 | 215 | 127 | 127 | 195 | 450 |
| 16 | ........ | 268 | 88 | 185 | 105 | 127 | 183 | 430 |
| 17 | ........ | 250 | 83 | 165 | 98 | 127 | 179 | 411 |
| 18 | ........ | 237 | 93 | 185 | 87 | 127 | 170 | 411 |
| 19 | ........ | 218 | 99 | 110 | 73 | 130 | 161 | 530 |
| 20 | ........ | 198 | 110 | 95 | 70 | 127 | 144 | 458 |
| 21 | ........ | 186 | 123 | 95 | 68 | 127 | 147 | 442 |
| 22 | 648 | 158 | 113 | 130 | 73 | 127 | 292 | 419 |
| 23 | 598 | 144 | 113 | 85 | 77 | 120 | 985 | 397 |
| 24 | 582 | 129 | 117 | 85 | 602 | 120 | 715 | 361 |
| 25 | 556 | 129 | 117 | 85 | 251 | 127 | 490 | 342 |
| 26 | 532 | 110 | 381 | 150 | 211 | 127 | 419 | 342 |
| 27 | 490 | 110 | 164 | 100 | 205 | 127 | 13,640 | 342 |
| 28 | 478 | 104 | 178 | 80 | 215 | 127 | 9,835 | 349 |
| 29 | 458 | 104 | 354 | 80 | 192 | 127 | 6,700 | 355 |
| 30 | 426 | 99 | 436 | 65 | 280 | 127 | 4,515 | 355 |
| 31 | 390 | ........ | 263 | 95 | ........ | 127 | ........ | 355 |

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly discharge of Gila River, near Cliff, N. Mex., for 1905.*

[Drainage area, 2,450 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May 22-31 | 648 | 390 | 516 | 10,230 | 0.211 | 0.078 |
| June | 458 | 99 | 272 | 16,180 | .111 | .124 |
| July | 436 | 72 | 133 | 8,178 | .054 | .062 |
| August | 436 | 65 | 182 | 11,190 | .074 | .085 |
| September | 602 | 68 | 192 | 11,420 | .078 | .087 |
| October | 268 | 120 | 149 | 9,162 | .061 | .070 |
| November | 13,640 | 127 | 1,392 | 82,830 | .568 | .634 |
| December | 3,190 | 342 | 665 | 40,890 | .271 | .312 |
| The period | | | | 190,100 | | |

## GILA RIVER AT SAN CARLOS, ARIZ.

This station was established July 11, 1899, in connection with the investigation of the water supply of the Gila Valley.[a] It is located one-half mile south of the Indian agency at San Carlos and below the mouth of San Carlos Creek.

The channel is straight for some distance above and below the station, and the water is comparatively swift. The right bank is high, but the left is low and liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from a cable and car a short distance above the gage rod. The gage at this station is read by R. H. Ross. The original gage was an inclined rod securely fastened to posts driven into the left bank. During the heavy floods of January, February, and March, 1905, the cable and gage were washed away, and there are breaks in the gage records for those months. In April and May, 1905, the station was visited by Mr. Gerard H. Matthes, who constructed an approximate gage record covering the period between April 1 and May 14, based on the data available at that time. On May 14 a chain gage was established on the right bank of the river about 500 feet below the new cable. In August, 1905, new cables were placed in position and the station was rebuilt. Owing to the fact that the channel left the chain gage during low water, an inclined gage was placed on the right bank of the stream about 60 feet above the cable for use at low stages. The zero of this gage coincides in elevation with the zero of the chain gage. The bench marks are as follows: (1) Nail in cottonwood tree on edge of bank 50 yards upstream from gage; elevation, 23.38 feet. (2) Nail in cottonwood tree near ditch back of gage; elevation, 20.58 feet. (3) Three nails driven at the same level in three forks of old cottonwood tree on irrigating ditch one-third mile north of gage; elevation, 23.85 feet. Elevations are above the zero of the gage. This station was discontinued December 31, 1905.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 38, pp 313-314; 50, p 385; 66, p 98; 85, pp 32-33; 100, p 48; 133, p 199.
Discharge: WS 38, p 314; 50, p 386; 66, p 99; 85, p 33; 100, p 50; 133, pp 200-202.
Discharge, mean daily: WS 133, p 203.
Discharge, monthly: Ann 21, iv, p 332; 22, iv, p 397; WS 75, p 179; 85, p 35; 100, p 51; 133, p 204.
Gage heights: WS 38, p 314; 50, p 386; 66, p 99; 85, p 34; 100, p 49; 133, p 202.
Hydrographs: Ann 21, iv, p 332; 22, iv, p 398; WS 75, p 180.
Rating tables: WS 39, p 452; 52, p 520; 85, pp 34-35.

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[a] The results of this investigation are set forth in Water-Supply and Irrigation Paper No. 33, entitle "Storage of Water on Gila River, Arizona," by J. B. Lippincott.

*Discharge measurements of Gila River at San Calos, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 6 | R. H. Ross | 1.45 | 127 |
| June 14 | Matthes & Rabinnovitz. | 11.12 | 422 |
| June 25 | F. Rabinnovitz | 10.80 | 28 |
| June 30 | do | 10.50 | 58 |
| July 14 | do | 10.82 | 178 |
| July 31 | do | 11.44 | 243 |
| August 5 | do | 11.15 | 213 |
| August 11 | do | 11.57 | 957 |
| September 17 | do | 11.50 | 168 |
| September 24 | do | 11.35 | 89 |
| September 30 | do | 12.10 | 760 |
| October 9 | do | 11.40 | 109 |
| October 12 | do | 11.30 | 78 |
| October 21 | do | 11.15 | 36 |
| October 24 | do | 11.10 | 46 |
| October 15 | F. Rabinnovitz | 11.25 | 117 |
| October 17 | do | 11.20 | 65 |
| October 26 | do | 11.05 | 42 |
| October 28 | do | 11.00 | 28 |
| October 30 | do | 11.05 | 57 |
| November 2 | do | 11.15 | 58 |
| November 4 | do | 11.10 | 76 |
| November 6 | do | 11.45 | 292 |
| November 10 | do | 12.45 | 1,438 |
| November 13 | do | 11.90 | 766 |
| November 15 | do | 11.75 | 461 |
| November 17 | do | 11.80 | 492 |
| November 20 | do | 11.70 | 381 |
| November 22 | do | 12.00 | 951 |
| November 24 | do | 13.20 | 3,237 |

*Daily gage height, in feet, of Gila River, at San Carlos. Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 1.7 | 5.6 | | 13.35 | 11.05 | 10.5 | 11.38 | 11.38 | 12.05 | 11.15 |
| 2 | 1.5 | 1.7 | 5.3 | 12.8 | 13.3 | 11.05 | 10.5 | 11.3 | 11.22 | 11.88 | 11.15 |
| 3 | 1.5 | 1.7 | 5.5 | 13.65 | 13.3 | 11.01 | 10.5 | 11.16 | 11.3 | 11.9 | 11.12 |
| 4 | 1.5 | 5.55 | 5.4 | 14.4 | 13.2 | 11.99 | 10.5 | 11.2 | 11.8 | 11.82 | 11.1 |
| 5 | 1.45 | 4.9 | 5.35 | 14.35 | 13.0, | 11.01 | 10.5 | 11.15 | 11.8 | 11.72 | 11.18 |
| 6 | 1.45 | 4.9 | 4.9 | 13.45 | 12.85 | 11.02 | 10.5 | 11.12 | 12.6 | 11.62 | 11.48 |
| 7 | 1.45 | 4.4 | 4.5 | 12.8 | 12.6 | 11.99 | 10.5 | 11.1 | 12.35 | 11.52 | 11.42 |
| 8 | 1.45 | 3.8 | 4.8 | 13.0 | 12.35 | 11.07 | 10.5 | 11.22 | 12.17 | 11.48 | 11.7 |
| 9 | 1.45 | 3.42 | 6.7 | 12.7 | 12.3 | 11.11 | 10.5 | 11.78 | 11.8 | 11.4 | 12.78 |
| 10 | 7.0 | 3.2 | 5.55 | 12.75 | 12.2 | 11.36 | 10.5 | 11.52 | 11.92 | 11.35 | 12.48 |
| 11 | | 3.15 | 5.1 | 12.9 | 12.2 | 11.26 | 10.55 | 11.52 | 11.95 | 11.35 | 12.2 |
| 12 | | 3.05 | 4.6 | 14.7 | 12.2 | 11.25 | 10.38 | 11.42 | 11.8 | 11.32 | 12.05 |
| 13 | | 2.95 | 4.1 | 14.9 | 12.05 | 11.22 | 10.62 | 11.34 | 11.7 | 11.3 | 11.92 |
| 14 | | 2.78 | 5.1 | 14.65 | 11.95 | 11.14 | 10.88 | 11.38 | 11.65 | 11.28 | 11.8 |
| 15 | | 2.7 | 5.1 | 14.15 | 11.9 | 11.14 | 10.7 | 11.27 | 11.6 | 11.22 | 11.78 |
| 16 | | 2.85 | 4.5 | 14.1 | 11.86 | 11.08 | 10.68 | 11.1 | 11.5 | 11.2 | 11.72 |
| 17 | | 5.05 | 8.0 | 14.3 | 11.82 | 11.06 | 10.6 | 11.07 | 11.5 | 11.2 | 11.75 |
| 18 | | 7.9 | | 14.5 | 11.81 | 11.07 | 10.58 | 11.02 | 11.42 | 11.15 | 11.7 |
| 19 | | 9.0 | | 14.0 | 11.8 | 11.05 | 10.5 | 11.04 | 11.35 | 11.15 | 11.65 |
| 20 | | 4.45 | | 13.9 | 11.77 | 11.01 | 10.48 | 11.1 | 11.32 | 11.15 | 11.68 |
| 21 | | 3.7 | | 13.75 | 11.69 | 11.26 | 10.45 | 11.04 | 11.28 | 11.15 | 11.65 |
| 22 | | 3.35 | | 13.7 | 11.65 | 10.72 | 10.28 | 11.55 | 11.25 | 11.15 | 12.0 |
| 23 | | 3.2 | | 13.7 | 11.59 | 10.92 | 10.18 | 11.17 | 11.25 | 11.12 | 13.02 |
| 24 | | 3.65 | | 14.3 | 11.57 | 10.9 | 10.13 | 11.56 | 11.75 | 11.1 | 13.2 |
| 25 | | 4.95 | | 14.5 | 11.48 | 10.84 | 10.13 | [a]11.45 | 12.08 | 11.1 | 13.1 |
| 26 | | 3.75 | | 14.85 | 11.43 | 10.79 | 10.1 | 11.45 | 12.62 | 11.05 | 12.8 |
| 27 | | 3.4 | | 14.6 | 11.35 | 10.72 | 10.11 | 11.35 | 12.35 | 11.0 | 14.88 |
| 28 | | 3.3 | | 14.0 | 11.28 | 10.66 | 10.87 | 11.22 | 12.15 | 11.0 | |
| 29 | | | | 13.7 | 11.21 | 10.62 | 11.5 | 11.65 | 12.0 | 11.0 | |
| 30 | | | | 13.45 | 11.16 | 10.55 | 11.58 | 11.1 | 12.08 | 11.02 | |
| 31 | | | | | 11.13 | | 11.4 | 11.1 | | 11.08 | |

[a] Gage washed out. River changed its course. New gage set same level.

## GILA RIVER AT DOME (GILA CITY), ARIZ.

This station was established October 15, 1903. It is located 20 miles above the junction of the Gila with the Colorado. The point of gaging first established was one-fourth mile north of the depot at Dome. The river now flows in a channel fully 1 mile north of the original channel.

The Gila carries an enormous amount of mud and sand. At times the waves of sand traveling along the bed of the stream are so large, the current is so swift, and the stream to shallow, that the water is broken into a uniform succession of waves 2 feet high and over. During 1905 there have been ten floods reaching a maximum mean discharge for twenty-four hours, as follows: Two floods of 95,000 second-feet or over; 1 flood of 80,000 second-feet or over; 2 floods of 40,000 second-feet or over; 5 floods of 13,000 second-feet or over. At every flood the channel shifts. The valley at its narrowest is half a mile wide and the waters may occupy any part or all of it. There is no place on the lower part of the Gila where a permanent cable can be erected at a reasonable expense.

Up to about 8,000 second-feet discharge measurements are made by means of a boat and cable above that by means of floats. When the Colorado above the Gila is known to be constant the crest of the flood is measured after it joins the Colorado at Yuma, and an allowance of 5 per cent is made for flattening of the crest between Dome and Yuma.

The gage observer is B. Rinehart. Fourteen gages have been put in by the hydrographer since the establishment of the station, not including temporary rods placed by the observer.

The permanent bench mark is a standard United States Geological Survey iron post at the southwest corner of depot under platform, marked "189 Y"; elevation, 189.60 feet above sea level and 31.97 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 133, p 204..
Discharge: 133, p 205.
Discharge, monthly: 133, p 206.
Gage heights: 100, p 27; 133, p 205.

*Discharge measurements of Gila River at Dome (Gila City), Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 14 | W. D. Smith | 8.25 | 3,323 | April 14 | W. D. Smith | 12.60 | [b]88,000 |
| January 15 | do | 9.20 | 4,287 | May 30 | do | 7.00 | [c]2,269 |
| January 15 | do | 9.90 | 4,941 | June 13 | do | 5.90 | 749 |
| January 16 | do | 12.80 | 17,300 | September 19 | do | 3.70 | 33 |
| January 17 | do | 14.60 | [a]23,000 | October 5 | do | 6.00 | 755 |
| January 24 | do | 6.10 | 2,305 | October 9 | do | 4.70 | 374 |
| February 8 | do | 16.95 | [a]80,000 | November 28 | do | 7.10 | 2,467 |
| March 20 | do | 13.10 | [a]95,000 | November 29 | do | 14.70 | [d]95,000 |
| April 4 | do | 9.00 | [b]6,552 | | | | |

[a] Estimated from gaging at Yuma, Ariz.

[b] Float measurement.

[c] Measurement made 4 miles above Yuma, Ariz.

[d] Estimated from the discharge of the Colorado River at Yuma and from gage observations at Dome Picacho, and Laguna.

*Daily gage height, in feet, of Gila River at Dome (Gila City), Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  | 3.1 | 8.05 | 8.5 | 9.1 | 6.7 |  |  |  |  |  |
| 2 |  | 2.75 | 10.65 | 8.5 | 8.8 | 6.5 | 4.4 |  |  |  |  |
| 3 |  | 2.45 | 11.55 | 8.3 | 8.9 | 6.0 |  |  | 6.6 |  |  |
| 4 |  | 2.3 | 9.5 | 8.6 | 8.7 |  | 4.2 |  | 6.4 |  |  |
| 5 |  | 3.55 | 8.0 | 8.9 | 8.3 |  |  |  | 6.0 |  | 8.2 |
| 6 |  | 7.0 | 7.3 | 9.6 | 8.4 |  | 4.0 |  | 5.6 |  | 8.0 |
| 7 |  | 14.0 | 6.15 | 9.8 | 8.3 |  |  |  | 5.0 |  | 7.7 |
| 8 |  | 16.95 | 5.4 | 9.0 | 8.0 |  | 3.9 |  |  |  | 7.6 |
| 9 |  | 15.45 | 5.2 | 8.8 | 8.0 |  |  |  | 4.7 |  | 7.5 |
| 10 | 3.0 | 13.1 | 5.0 | 8.9 | 8.0 |  | 3.8 |  |  |  | 7.7 |
| 11 | 7.0 | 10.75 | 8.0 | 9.0 | 7.7 |  |  |  | 4.3 |  | 7.5 |
| 12 | 7.5 | 7.25 | 9.2 | 8.9 | 8.2 |  | 3.7 |  |  |  | 7.4 |
| 13 | 7.8 | 4.25 | 7.6 | 10.7 | 8.0 | 5.9 |  | 4.8 | 4.0 |  |  |
| 14 | 7.95 | 6.75 | 7.5 | 12.6 | 7.8 | 5.9 | 3.7 | 4.6 |  | 4.5 | 7.4 |
| 15 | 9.45 | 5.0 | 9.25 | 11.55 | 7.9 |  |  | 4.4 | 3.7 | 5.0 |  |
| 16 | 13.7 | 4.0 | 11.8 | 10.8 | 8.0 | 6.0 | 3.6 |  |  | 5.0 | 7.5 |
| 17 | 14.6 | 4.55 | 10.5 | 10.0 | 8.0 |  |  | 3.8 | 3.6 |  |  |
| 18 | 12.0 | 4.8 | 11.15 | 9.35 | 7.9 | 5.9 | 3.6 |  |  | 4.5 | 7.6 |
| 19 | 10.1 | 10.95 | 12.55 | 8.85 | 7.6 |  |  | 3.7 | 3.5 |  |  |
| 20 | 8.7 | 11.95 | 13.1 | 8.35 | 7.8 | 5.7 | 3.5 |  |  | 4.2 | 7.6 |
| 21 | 8.05 | 12.05 | 11.0 | 8.05 | 7.6 |  |  | 3.6 |  |  |  |
| 22 | 7.45 | 11.85 | 10.5 | 8.4 | 7.7 | 5.4 | 3.5 | 3.5 |  | 4.1 | 7.6 |
| 23 | 6.65 | 5.7 | 10.3 | 8.85 | 7.8 |  |  | 3.5 |  |  | 7.7 |
| 24 | 6.1 | 5.0 | 10.1 | 8.75 | 7.6 | 5.1 |  |  |  | 4.1 | 7.7 |
| 25 | 5.75 | 6.0 | 9.9 | 9.05 | 7.5 |  |  |  |  |  |  |
| 26 | 5.45 | 9.05 | 9.7 | 9.65 | 7.5 | 4.9 |  |  |  | 4.1 | 7.8 |
| 27 | 5.25 | 8.05 | 9.5 | 9.55 | 7.5 |  |  |  |  |  |  |
| 28 | 4.95 | 8.1 | 9.3 | 9.7 | 7.4 | 4.7 |  |  |  | 6.1 | 7.5 |
| 29 | 4.6 |  | 9.1 | 9.65 | 7.2 |  |  |  |  | 14.7 |  |
| 30 | 4.1 |  | 8.9 | 9.4 | 7.0 | 4.5 |  |  |  | 12.6 | 7.4 |
| 31 | 3.6 |  | 8.7 |  | 6.9 |  |  |  |  |  | 7.4 |

NOTE.—No gage record June 4 to 12. No flow during August.

*Daily discharge, in second-feet, of Gila River at Dome (Gila City), Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  | 80 | 5,150 | 6,800 | 9,500 | 1,850 | 280 |  |  |  | 30,700 |
| 2 |  |  | 21,500 | 6,800 | 8,100 | 1,550 | 270 |  |  |  | 24,400 |
| 3 |  |  | 34,000 | 6,000 | 8,500 | 900 | 240 |  | 940 |  | 18,200 |
| 4 |  |  | 11,800 | 7,300 | 7,700 | 880 | 210 |  | 870 |  | 11,900 |
| 5 |  | 280 | 5,000 | 8,500 | 6,000 | 860 | 180 |  | 750 |  | 5,700 |
| 6 |  | 2,220 | 3,050 | 12,400 | 6,400 | 840 | 150 |  | 630 |  | 5,000 |
| 7 |  | 20,800 | 1,050 | 13,800 | 6,000 | 830 | 140 |  | 450 |  | 4,100 |
| 8 |  | 82,000 | 450 | 9,000 | 5,000 | 810 | 120 |  | 400 |  | 3,800 |
| 9 |  | 35,800 | 370 | 8,100 | 5,000 | 790 | 100 |  | 360 |  | 3,600 |
| 10 | 40 | 14,900 | 300 | 8,500 | 5,000 | 770 | 90 |  | 300 |  | 4,100 |
| 11 | 2,220 | 6,900 | 5,000 | 9,000 | 4,100 | 750 | 80 |  | 240 |  | 3,600 |
| 12 | 2,600 | 2,920 | 10,000 | 8,500 | 5,600 | 730 | 60 |  | 200 |  | 3,300 |
| 13 | 2,840 | 60 | 3,800 | 22,000 | 5,000 | 720 | 60 | 390 | 150 |  | 3,300 |
| 14 | 2,960 | 1,920 | 3,500 | 64,000 | 4,400 | 720 | 60 | 330 | 100 | 390 | 3,300 |
| 15 | 4,680 | 300 | 10,300 | 34,000 | 4,700 | 740 | 40 | 270 | 60 | 450 | 3,400 |
| 16 | 18,600 |  | 39,000 | 23,000 | 5,000 | 750 | 30 | 180 | 40 | 450 | 3,600 |

*Daily discharge, in second-feet, of Gila River at Dome (Gila City), Ariz., for 1905*—Cont'd.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 26,000 | 140 | 20,000 | 15,300 | 5,000 | 740 | 30 | 90 | 30 | 380 | 3,700 |
| 18 | 10,200 | 230 | 27,800 | 10,900 | 4,700 | 720 | 30 | 80 | 20 | 300 | 3,800 |
| 19 | 5,650 | 24,800 | 62,000 | 8,300 | 3,800 | 690 | 20 | 60 | ....... | 260 | 3,800 |
| 20 | 3,690 | 42,800 | 95,000 | 6,200 | 4,400 | 660 | ....... | 40 | ....... | 210 | 3,800 |
| 21 | 3,060 | 45,200 | 25,500 | 5,150 | 3,800 | 620 | ....... | 30 | ....... | 200 | 3,800 |
| 22 | 2,560 | 40,200 | 20,000 | 6,400 | 4,100 | 570 | ....... | 20 | ....... | 180 | 3,800 |
| 23 | 1,990 | 630 | 18,000 | 8,300 | 4,400 | 520 | ....... | ....... | ....... | 180 | 4,100 |
| 24 | 1,660 | 300 | 16,100 | 7,900 | 3,800 | 480 | ....... | ....... | ....... | 180 | 4,100 |
| 25 | 1,460 | 900 | 14,500 | 9,250 | 3,500 | 450 | ....... | ....... | ....... | 180 | 4,200 |
| 26 | 1,290 | 9,250 | 13,100 | 12,750 | 3,500 | 420 | ....... | ....... | ....... | 180 | 4,400 |
| 27 | 1,180 | 5,150 | 11,800 | 12,100 | 3,500 | 390 | ....... | ....... | ....... | 480 | 4,000 |
| 28 | 1,020 | 5,300 | 10,600 | 13,100 | 3,300 | 360 | ....... | ....... | ....... | 780 | 3,600 |
| 29 | 830 | ....... | 9,500 | 12,750 | 2,800 | 330 | ....... | ....... | ....... | 95,000 | 3,400 |
| 30 | 560 | ....... | 8,500 | 11,200 | 2,350 | 300 | ....... | ....... | ....... | 36,900 | 3,300 |
| 31 | 310 | ....... | 7,700 | ....... | 2,150 | ....... | ....... | ....... | ....... | ....... | 3,300 |

NOTE.—Daily discharge obtained from several rating tables, each covering a short period of time. Discharge estimated for missing gage heights. No flow during August.

*Estimated monthly discharge of Gila River at Dome (Gila City), Ariz., for 1905.*

[Drainage area, 71,050 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 26,000 | 0 | 3,077 | 189,200 | 0.043 | 0.050 |
| February | 82,000 | 0 | 12,250 | 680,300 | .172 | .179 |
| March | 95,000 | 300 | 16,590 | 1,020,000 | .233 | .269 |
| April | 64,000 | 5,150 | 12,910 | 768,200 | .182 | .203 |
| May | 9,500 | 2,150 | 4,874 | 299,700 | .069 | .080 |
| June | 1,850 | 300 | 725 | 43,140 | .010 | .011 |
| July | 280 | 0 | 70.6 | 4,341 | .00099 | .0011 |
| August | 0 | 0 | 0 | 0 | .0 | .0 |
| September | 390 | 0 | 49.7 | 2,957 | .00070 | .00078 |
| October | 940 | 0 | 179 | 11,010 | .0025 | .0029 |
| November | 95,000 | 0 | 4,557 | 271,200 | .064 | .071 |
| December | 30,700 | 3,300 | 6,100 | 375,100 | .086 | .099 |
| The year | 95,000 | 0 | 5,115 | 3,665,000 | .072 | .967 |

## SAN FRANCISCO RIVER AT ALMA, N. MEX.

This station was established October 18, 1904. It is located about one-half mile south of Alma, N. Mex., and 85 miles northwest of Silver City. It is best reached by stage from Silver City, which makes the trip daily except Sundays.

The channel is straight for about 500 feet above and below the station. The banks are about 4 feet high, are clean, and are subject to overflow during extreme high water. The bed of the stream is composed of gravel, is free from vegetation, and is firm and regular. The current is swift.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the zero of the tagged wire. The cable was carried away by a heavy flood on March 16, 1905, but was recovered and restored at a point about 600 feet higher upstream on March 24. Measurements prior to March 16 were taken at the lower section; since then the upper section has been used.

The gage, which is read twice each day by Mrs. Ella D. Hollimon, consists of a staff fastened to the east or left bank of the stream. The gage was washed out by the flood of March 16, 1905, but was immediately replaced in its old position. The bench mark is a 20-penny nail driven into a blaze in a cottonwood tree 118.5 feet N. 73° E. from the gage; it is marked "U. S. G. S. B. M."; elevation above the zero of the gage, 9.06 feet.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 206–208.

*Discharge measurements of San Francisco River at Alma, N. Mex., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| February 8 | Frank Asplind | 4.50 | [a]362 | May 30 | Frank Asplind | 2.25 | 63 |
| February 10 | do | 3.70 | [a]172 | May 30 | do | 2.25 | [a]60 |
| February 14 | do | 3.96 | [a]209 | May 31 | do | 2.2 | 54 |
| February 27 | do | 4.30 | [a]294 | June 3 | do | 2.15 | 43 |
| March 4 | do | 5.20 | [a]1,463 | June 4 | do | 2.15 | [a]45 |
| March 11 | do | 3.80 | [a]767 | June 6 | do | 2.10 | 35 |
| March 13 | do | 3.20 | [a]385 | June 7 | do | 2.10 | [a]32 |
| March 14 | do | 4.4 | [a]1,098 | June 16 | do | 2.65 | 24 |
| March 15 | do | 4.6 | [a]1,207 | June 17 | do | 2.05 | [a]22 |
| March 16 | do | 4.0 | [a]925 | June 19 | do | 2.00 | 22 |
| March 25 | do | 4.1 | [a]1,068 | June 20 | do | 2.00 | [a]21 |
| March 27 | do | 4.2 | [a]1,065 | June 21 | do | 1.95 | 16.8 |
| April 3 | do | 5.70 | [a]2,835 | June 23 | do | 1.90 | 12.4 |
| April 4 | do | 4.30 | [a]1,634 | June 24 | do | 1.85 | 9.1 |
| April 6 | do | 5.40 | [a]2,517 | June 26 | do | 1.80 | 5.8 |
| April 7 | do | 5.00 | [a]2,115 | June 29 | do | 1.75 | 4.0 |
| April 11 | do | 4.20 | [a]1,336 | July 15 | do | 1.95 | 15.5 |
| April 12 | do | 4.70 | [a]1,719 | July 15 | do | 2.00 | 21 |
| April 14 | do | 4.50 | [a]1,546 | July 18 | do | 1.90 | 12.5 |
| April 18 | do | 3.90 | 933 | July 20 | do | 2.15 | 40 |
| April 19 | do | 3.80 | 806 | July 21 | do | 2.20 | 52 |
| April 22 | do | 3.55 | 502 | August 1 | do | 2.15 | 33 |
| April 24 | do | 4.50 | 1,478 | August 2 | do | 2.15 | 29 |
| April 26 | do | 4.05 | 1,128 | August 3 | do | 2.10 | 23 |
| April 27 | do | 3.90 | 970 | August 4 | do | 2.18 | 33 |
| April 29 | do | 3.75 | 828 | August 5 | do | 2.20 | 40 |
| May 2 | do | 3.55 | 629 | August 8 | do | 2.50 | 104 |
| May 4 | do | 3.30 | 479 | August 9 | do | 2.20 | 39 |
| May 6 | do | 3.00 | [a]359 | August 10 | do | 2.20 | 40 |
| May 9 | do | 3.00 | 333 | August 11 | do | 2.22 | 46 |
| May 12 | do | 2.90 | 289 | August 11 | do | 2.45 | 79 |
| May 12 | do | 2.90 | [a]251 | August 12 | do | 2.30 | 54 |
| May 14 | do | 2.85 | 261 | August 14 | do | 2.15 | 27 |
| May 14 | do | 2.85 | [a]238 | August 15 | do | 2.10 | 19.2 |
| May 16 | do | 2.80 | 234 | August 16 | do | 2.05 | 16.7 |
| May 16 | do | 2.80 | [a]211 | August 30 | do | 2.15 | 10.9 |
| May 25 | do | 2.4 | 95 | August 31 | do | 2.30 | 31 |
| May 26 | do | 2.4 | [a]95 | September 2 | do | 2.20 | 16.1 |
| May 27 | do | 2.35 | 83 | September 3 | do | 3.55 | [a]741 |
| May 28 | do | 2.30 | 72 | September 4 | do | 2.40 | 65 |
| May 28 | do | 2.30 | [a]70 | September 4 | do | 4.30 | [a]1,218 |

[a] Float measurement.

*Discharge measurements of San Francisco River at Alma, N. Mex., in 1905*—Continued.

| Date | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| September 5 | Frank Asplind | 2.82 | 248 | October 24 | Frank Asplind | 2.40 | 68 |
| September 6 | do | 3.25 | 455 | November 7 | do | 2.40 | 59 |
| September 7 | do | 2.32 | 80 | November 8 | do | 3.20 | 220 |
| September 8 | do | 2.25 | 58 | November 9 | do | 2.72 | 99 |
| September 9 | do | 2.30 | 71 | November 10 | do | 2.52 | 68 |
| September 11 | do | 2.20 | 49 | November 11 | do | 2.40 | 51 |
| September 12 | do | 2.15 | 39 | November 13 | do | 2.45 | 61 |
| September 13 | do | 2.10 | 30 | November 15 | do | 2.40 | 54 |
| September 14 | do | 2.10 | 28 | November 17 | do | 2.40 | 55 |
| September 16 | do | 2.10 | 28 | November 18 | do | 2.40 | 55 |
| October 2 | do | 2.30 | [a] 58 | December 6 | do | 2.25 | 167 |
| October 3 | do | 2.25 | [a] 46 | December 7 | do | 1.95 | 107 |
| October 4 | do | 2.20 | 37 | December 9 | do | 1.75 | 72 |
| October 5 | do | 2.20 | 37 | December 11 | do | 1.75 | 68 |
| October 6 | do | 2.20 | 36 | December 12 | do | 1.70 | 60 |
| October 7 | do | 2.20 | 36 | December 13 | do | 1.70 | 59 |
| October 9 | do | 2.20 | 37 | December 14 | do | 1.65 | 50 |
| October 10 | do | 2.20 | 36 | December 15 | do | 1.60 | 42 |
| October 11 | do | 2.20 | 34 | December 16 | do | 1.62 | 46 |
| October 12 | do | 2.20 | 36 | December 18 | do | 1.60 | 42 |
| October 13 | do | 2.20 | 36 | December 19 | do | 1.60 | 43 |
| October 14 | do | 2.20 | 35 | December 20 | do | 1.60 | 42 |
| October 16 | do | 2.20 | 35 | December 22 | do | 1.60 | 43 |
| October 18 | do | 2.20 | 34 | December 23 | do | 1.50 | 34 |
| October 19 | do | 2.20 | 36 | December 26 | do | 1.45 | 30 |
| October 20 | do | 2.20 | 35 | December 28 | do | 1.50 | 33 |
| October 21 | do | 2.20 | 33 | December 29 | do | 1.45 | 28 |
| October 23 | do | 2.40 | 68 | December 30 | do | 1.45 | 27 |

[a] Float measurement.

*Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 2.2 | 5.85 | 3.6 | 3.52 | 2.2 | 1.8 | 2.35 | 2.3 | 2.5 | 2.3 | ....... |
| 2 | 1.2 | 2.8 | 5.5 | 4.15 | 3.5 | 2.18 | 1.8 | 2.1 | 2.2 | 2.48 | 2.5 | ....... |
| 3 | 1.2 | 2.45 | 5.55 | 5.0 | 3.4 | 2.1 | 1.8 | 2.05 | 2.2 | 2.35 | 2.5 | 2.42 |
| 4 | 1.2 | 5.0 | 5.55 | 4.4 | 3.4 | 2.1 | 1.78 | 2.05 | 2.5 | 2.3 | 2.6 | 2.42 |
| 5 | 1.2 | 5.0 | 5.6 | 4.9 | 3.3 | 2.0 | 1.75 | 2.1 | 2.5 | 2.3 | 2.9 | 2.32 |
| 6 | 1.2 | 5.15 | 4.7 | 4.85 | 3.15 | 2.0 | 1.78 | 2.15 | 2.4 | 2.2 | 3.8 | 2.25 |
| 7 | 1.2 | 4.8 | 5.0 | 4.75 | 3.1 | 2.0 | 1.8 | 2.05 | 2.3 | 2.2 | 3.6 | 2.1 |
| 8 | 1.2 | 4.5 | 5.42 | 4.6 | 3.1 | 2.2 | 1.8 | 3.25 | 2.3 | 2.2 | 3.8 | 1.85 |
| 9 | 1.75 | 4.25 | 4.35 | 4.25 | 3.1 | 2.18 | 1.8 | 2.35 | 2.3 | 2.2 | 3.0 | 1.8 |
| 10 | 5.85 | 3.7 | 3.75 | 4.25 | 3.0 | 2.1 | 1.8 | 2.2 | 2.25 | 2.15 | 2.52 | 1.72 |
| 11 | 3.4 | 3.2 | 3.6 | 4.2 | 3.0 | 2.1 | 1.8 | 2.5 | 2.22 | 2.15 | 2.5 | 1.7 |
| 12 | 2.65 | 3.5 | 3.4 | 4.45 | 2.95 | 2.1 | 1.8 | 2.35 | 2.22 | 2.2 | 2.42 | 1.68 |
| 13 | 2.4 | 3.7 | 3.2 | 4.95 | 2.9 | 2.0 | 1.8 | 2.3 | 2.15 | 2.2 | 2.4 | 1.68 |
| 14 | 2.35 | 3.9 | 4.35 | 4.42 | 2.82 | 2.0 | 1.8 | 2.2 | 2.12 | 2.2 | 2.4 | 1.68 |
| 15 | 2.3 | 3.65 | 4.3 | 4.2 | 2.8 | 2.0 | 1.9 | 2.2 | 2.1 | 2.2 | 2.4 | 1.62 |
| 16 | 2.3 | 3.85 | 4.0 | 3.95 | 2.8 | 2.0 | 1.9 | 2.18 | 1.98 | 2.2 | 2.4 | 1.62 |
| 17 | 2.3 | 6.3 | 5.9 | 3.85 | 2.77 | 2.0 | 2.0 | 2.12 | 2.0 | 2.2 | 2.4 | 1.58 |
| 18 | 2.3 | 6.4 | 5.1 | 3.85 | 2.75 | 1.92 | 1.9 | 2.1 | 2.0 | 2.2 | 2.4 | 1.52 |

*Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 2.3 | 3.75 | 4.7 | 3.8 | 2.75 | 1.95 | 1.9 | 2.1 | 2.0 | 2.2 | 2.35 | 1.52 |
| 20 | 2.22 | 3.8 | 5.2 | 3.7 | 2.7 | 1.9 | 2.1 | 2.0 | 2.0 | 2.2 | 2.35 | 1.52 |
| 21 | 2.22 | 3.0 | 4.6 | 3.6 | 2.7 | 1.9 | 2.1 | 2.85 | 2.1 | 2.2 | 2.52 | 1.62 |
| 22 | 2.21 | 2.9 | 4.5 | 3.52 | 2.7 | 1.9 | 2.1 | 2.8 | 2.2 | 2.2 | 3.85 | 1.65 |
| 23 | 2.21 | 4.35 | 4.5 | 4.55 | 2.55 | 1.9 | 2.15 | 2.35 | 3.2 | 2.2 | 3.62 | 1.62 |
| 24 | 2.2 | 3.22 | 4.3 | 4.7 | 2.5 | 1.9 | 2.0 | 2.1 | 4.65 | 2.4 | 3.3 | 1.62 |
| 25 | 2.15 | 3.95 | 4.1 | 4.4 | 2.45 | 1.88 | 2.0 | 2.05 | 3.5 | 2.38 | 2.7 | 1.52 |
| 26 | 2.1 | 3.75 | 4.1 | 4.0 | 2.42 | 1.82 | 2.0 | 2.1 | 3.2 | 2.3 | 2.62 | 1.42 |
| 27 | 2.1 | 4.4 | 4.0 | 3.9 | 2.37 | 1.8 | 2.0 | 2.1 | 3.2 | 2.3 | ....... | 1.42 |
| 28 | 2.1 | 6.05 | 3.85 | 4.0 | 2.3 | 1.8 | 2.0 | 2.15 | 3.12 | 2.3 | ....... | 1.42 |
| 29 | 2.2 | ....... | 3.75 | 3.7 | 2.27 | 1.8 | 2.75 | 2.3 | 2.8 | 2.3 | ....... | 1.38 |
| 30 | 2.35 | ....... | 3.5 | 3.5 | 2.25 | 1.8 | 2.25 | 3.05 | 2.6 | 2.3 | ....... | 1.38 |
| 31 | 2.5 | ....... | 3.55 | ....... | 2.22 | ....... | 2.35 | 2.85 | ....... | 2.3 | ....... | 1.38 |

*Daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 190 | 3,410 | 681 | 618 | 52 | 6 | 72 | 27 | 115 | 45 | ....... |
| 2 | 10 | 570 | 2,360 | 1,155 | 602 | 48 | 6 | 24 | 16 | 100 | 85 | ....... |
| 3 | 10 | 287 | 2,510 | 2,048 | 548 | 32 | 6 | 18 | 75 | 65 | 85 | 215 |
| 4 | 10 | 910 | 2,510 | 1,380 | 548 | 32 | 5 | 21 | 90 | 55 | 115 | 215 |
| 5 | 10 | 910 | 2,660 | 1,932 | 494 | 20 | 4 | 26 | 120 | 55 | 210 | 185 |
| 6 | 10 | 1,310 | 460 | 1,874 | 413 | 20 | 5 | 32 | 85 | 36 | 755 | 162 |
| 7 | 10 | 560 | 910 | 1,758 | 386 | 20 | 6 | 20 | 74 | 36 | 575 | 120 |
| 8 | 10 | 370 | 2,120 | 1,590 | 386 | 52 | 6 | 425 | 74 | 36 | 550 | 74 |
| 9 | 80 | 295 | 325 | 1,245 | 386 | 48 | 6 | 72 | 74 | 36 | 190 | 67 |
| 10 | 3,162 | 170 | 180 | 1,245 | 332 | 32 | 6 | 40 | 63 | 25 | 75 | 56 |
| 11 | 1,080 | 110 | 155 | 1,200 | 332 | 32 | 6 | 110 | 36 | 25 | 70 | 53 |
| 12 | 357 | 140 | 130 | 1,430 | 306 | 32 | 6 | 63 | 56 | 36 | 60 | 51 |
| 13 | 260 | 170 | 110 | 1,990 | 280 | 20 | 6 | 50 | 42 | 36 | 55 | 51 |
| 14 | 240 | 210 | 325 | 1,400 | 240 | 20 | 6 | 33 | 36 | 36 | 55 | 51 |
| 15 | 220 | 163 | 310 | 1,200 | 230 | 20 | 12 | 30 | 32 | 36 | 55 | 44 |
| 16 | 220 | 200 | 230 | 975 | 230 | 20 | 12 | 30 | 18 | 36 | 55 | 44 |
| 17 | 220 | 4,760 | 3,092 | 885 | 215 | 20 | 20 | 23 | 17 | 36 | 55 | 40 |
| 18 | 220 | 5,060 | 2,164 | 885 | 205 | 14 | 12 | 19 | 17 | 36 | 55 | 35 |
| 19 | 220 | 180 | 1,700 | 840 | 205 | 16 | 12 | 16 | 17 | 36 | 45 | 35 |
| 20 | 196 | 190 | 2,280 | 760 | 180 | 12 | 32 | 9 | 17 | 36 | 45 | 35 |
| 21 | 196 | 90 | 1,590 | 681 | 180 | 12 | 32 | 75 | 25 | 36 | 85 | 44 |
| 22 | 193 | 80 | 1,480 | 618 | 180 | 12 | 32 | 55 | 40 | 36 | 750 | 48 |
| 23 | 193 | 325 | 1,480 | 1,535 | 135 | 12 | 42 | 42 | 415 | 36 | 585 | 44 |
| 24 | 190 | 112 | 1,290 | 1,700 | 120 | 12 | 20 | 12 | 1,575 | 68 | 405 | 44 |
| 25 | 175 | 220 | 1,110 | 1,380 | 107 | 11 | 20 | 8 | 565 | 60 | 125 | 35 |
| 26 | 160 | 180 | 1,110 | 1,020 | 99 | 8 | 20 | 11 | 405 | 45 | 110 | 27 |
| 27 | 160 | 340 | 1,020 | 930 | 88 | 6 | 20 | 9 | 405 | 45 | ....... | 27 |
| 28 | 160 | 4,010 | 885 | 1,020 | 74 | 6 | 20 | 11 | 365 | 45 | ....... | 27 |
| 29 | 190 | ....... | 800 | 760 | 88 | 6 | 205 | 23 | 195 | 45 | ....... | 25 |
| 30 | 240 | ....... | 602 | 602 | 64 | 6 | 63 | 220 | 125 | 45 | ....... | 25 |
| 31 | 315 | ....... | 642 | ....... | 58 | ....... | 85 | 160 | ....... | 45 | ....... | 25 |

**Note.**—Daily discharge obtained by indirect method.

*Estimated monthly discharge of San Francisco River at Alma, N. Mex., for 1905.*

[Drainage area, 1,800 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3,162 | 10 | 282 | 17,340 | 0.157 | 0.181 |
| February | 5,060 | 80 | 790 | 43,870 | .439 | .457 |
| March | 3,410 | 110 | 1,289 | 79,260 | .716 | .826 |
| April | 2,048 | 602 | 1,224 | 72,830 | .680 | .759 |
| May | 618 | 58 | 269 | 16,540 | .149 | .172 |
| June | 52 | 6 | 21.8 | 1,297 | .012 | .013 |
| July | 205 | 4 | 23.8 | 1,463 | .013 | .015 |
| August | 425 | 8 | 56.7 | 3,486 | .032 | .037 |
| September | 1,575 | 16 | 170 | 10,120 | .094 | .105 |
| October | 115 | 25 | 45.6 | 2,804 | .025 | .029 |
| November 1-26 | 755 | 45 | 204 | 10,520 | .113 | .109 |
| December 3-31 | 215 | 25 | 65.7 | 3,779 | .036 | .039 |
| The period | | | | 263,300 | | |

## SAN PEDRO RIVER AT CHARLESTON, ARIZ.

This station was established January 22, 1904. It is located about one-half mile west of Charleston station on the El Paso and Southwestern Railroad and 6 miles south of Fairbank, Ariz.

The channel is straight for about 800 feet above and 500 feet below the station. Both banks are nearly vertical for 20 feet, are clean, and are not subject to overflow. The bed of the stream is composed of sand and is shifting. At high water there is but one channel, but at low water the channel is divided by sand bars. The current is swift.

Discharge measurements are made at high water by a cable and car 10 feet below the gage. The initial point for soundings is 21 feet from the cable support on the east bank. Low-water measurements are made by wading.

The gage is read twice each day by H. R. Fry. The original gage was read until March 28, 1904, when a second gage was established 200 feet upstream from the first. The second gage, which was read from March 29 to July 30, 1904, is in two sections: The upper section is attached vertically to a cottonwood tree on the left bank; the upper end of the lower section, which is inclined, is fastened to the same tree and the lower end is set in the bed of the stream. In July and August, 1904, floods changed the channel to such an extent that a third gage became necessary. This was established August 15, 1904, on the east bank, directly opposite the old or second gage, and consists of a vertical rod fastened to a deadman in the bank at the same datum as the old gage. Readings have since been made from the third gage. The bench marks are as follows: (1) A United States Geological Survey standard iron bench-mark post near a post on the east side of the El Paso and Southwestern Railroad station at Charleston; elevation, 57.265 feet above the zero of the gage and 3,957.265 feet above mean sea level. (2) A spike in the west side of the root of a tree on the west bank of the river, 100 feet above the gage; elevation, 35.860 feet above the zero of the gage and 3,935.860 feet above mean sea level.

A description of this station, with gage-height and discharge data, is contained in Water-Supply Paper No. 133, United States Geological Survey, pages 208-211.

*Discharge measurements of San Pedro River at Charleston, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Dis-charge. | Date. | Hydrographer. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft* |
| January 4 | H. R. Fry | 26.05 | 24 | June 28 | H. R. Fry | 26.30 | 17 |
| January 11 | do | 26.90 | 124 | July 5 | do | 26.15 | 12 |
| January 18 | do | 26.80 | 35 | July 12 | do | 27.30 | 122 |
| January 25 | do | 26.70 | 31 | July 19 | do | 26.25 | 14 |
| February 1 | do | 26.40 | 23 | July 29 | do | 26.50 | 61 |
| February 9 | do | 27.25 | 120 | August 7 | do | ....... | 38 |
| February 15 | do | 26.60 | 36 | August 12 | do | 26.00 | 46 |
| February 21 | do | 27.35 | 147 | August 17 | do | 26.05 | 82 |
| March 1 | do | 27.10 | 111 | August 26 | do | 26.80 | 133 |
| March 22 | do | 26.85 | 81 | September 7 | do | 26.30 | 80 |
| March 30 | do | 26.80 | 99 | September 15 | do | 25.60 | 37 |
| April 5 | do | 26.30 | 71 | September 21 | do | 25.70 | 38 |
| April 12 | do | 26.20 | 50 | September 28 | do | 26.10 | 62 |
| April 19 | do | 26.30 | 79 | October 4 | W. Rayling | 25.60 | 28 |
| April 26 | do | 26.00 | 37 | October 11 | do | 25.50 | 34 |
| May 3 | do | 26.15 | 51 | October 18 | do | 25.60 | 31 |
| May 10 | do | 25.95 | 31 | October 25 | do | 25.50 | 27 |
| May 17 | do | 25.85 | 25 | November 1 | do | 25.50 | 23 |
| May 24 | do | 25.85 | 22 | November 8 | do | 25.40 | 24 |
| May 24 | do | 25.85 | 20 | November 15 | do | 25.70 | 42 |
| May 31 | do | 25.82 | 18 | November 22 | do | 25.80 | 54 |
| June 7 | do | 25.80 | 18 | December 6 | do | ....... | 98 |
| June 14 | do | 26.65 | 52 | December 13 | do | ....... | 102 |
| June 21 | do | 26.35 | 20 | December 20 | do | 25.50 | 61 |
| June 28 | do | 26.30 | 20 | December 27 | do | 25.40 | 54 |

**NOTE.**—Gage washed away by flood on November 28.

*Daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 26.15 | 26.4 | 27.1 | 26.65 | 26.35 | 25.82 | 26.25 | ....... | 25.65 | 25.8 | 25.5 | ....... |
| 2 | 26.1 | 26.4 | 28.02 | 26.57 | 26.25 | 25.82 | 26.25 | ....... | 26.85 | 25.8 | 25.5 | ....... |
| 3 | 26.1 | 26.4 | 27.52 | 26.45 | 26.15 | 25.82 | 26.25 | ....... | 27.6 | 25.7 | 25.5 | ....... |
| 4 | 26.05 | 26.5 | 27.7 | 26.3 | 26.15 | 25.82 | 26.22 | ....... | 27.75 | 25.6 | 25.5 | ....... |
| 5 | 26.05 | 27.1 | 27.8 | 26.27 | 26.05 | 25.78 | 26.15 | ....... | 28.25 | 25.5 | 25.5 | ....... |
| 6 | 26.05 | 26.62 | 27.45 | 26.22 | 26.05 | 25.8 | 26.18 | ....... | 26.5 | 25.5 | 25.5 | ....... |
| 7 | 26.1 | 27.9 | 27.75 | 26.17 | 26.05 | 25.8 | 26.18 | ....... | 26.35 | 25.35 | 25.35 | ....... |
| 8 | 26.1 | 27.6 | 28.85 | 26.1 | 25.92 | 25.85 | 26.18 | ....... | 26.45 | 25.5 | 27.2 | ....... |
| 9 | 26.1 | 27.2 | 27.85 | 26.1 | 25.92 | 26.00 | 26.22 | 27.5 | 26.0 | 25.5 | 27.55 | ....... |
| 10 | 26.65 | 26.87 | 28.5 | 26.1 | 25.95 | 27.65 | 26.22 | 26.9 | 25.95 | 25.5 | 26.75 | ....... |
| 11 | 26.9 | 26.85 | 27.35 | 26.1 | 25.9 | 27.15 | 26.48 | 26.8 | 25.55 | 25.5 | 26.7 | ....... |
| 12 | 26.9 | 26.8 | 27.87 | 26.2 | 25.9 | 26.85 | 27.28 | 26.0 | 25.55 | 27.0 | 25.9 | ....... |
| 13 | 26.85 | 26.7 | 27.1 | 26.47 | 25.87 | 26.68 | 27.32 | 26.35 | 25.55 | 27.0 | 25.8 | ....... |
| 14 | 26.9 | 26.65 | 27.06 | 27.3 | 25.85 | 26.6 | 26.62 | 27.0 | 25.55 | 26.45 | 25.7 | ....... |
| 15 | 26.9 | 26.6 | 27.1 | 26.9 | 25.85 | 26.6 | 26.45 | 26.05 | 25.9 | 26.2 | 25.7 | ....... |
| 16 | 26.95 | 26.6 | 26.9 | 26.5 | 25.82 | 26.52 | 26.35 | 26.85 | 26.3 | 26.0 | 25.7 | ....... |
| 17 | 26.85 | 26.65 | 30.85 | 26.3 | 25.82 | 26.5 | 26.32 | 27.92 | 26.4 | 25.8 | 25.7 | 25.5 |
| 18 | 26.85 | 26.85 | 28.25 | 26.3 | 25.82 | 26.42 | 26.25 | 26.1 | 26.35 | 25.6 | 25.6 | 25.5 |
| 19 | 26.8 | 27.65 | 27.6 | 26.27 | 25.82 | 26.42 | 26.25 | 27.75 | 25.9 | 25.6 | 25.6 | 25.5 |
| 20 | 26.8 | 27.8 | 27.23 | 26.2 | 25.8 | 26.35 | 26.2 | 28.15 | 25.7 | 25.6 | 25.6 | 25.5 |
| 21 | 26.8 | 27.27 | 26.95 | 26.15 | 25.83 | 26.35 | 26.22 | 29.1 | 26.2 | 25.6 | 25.6 | 25.6 |

*Daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 26.8 | 27.12 | 26.85 | 26.2 | 25.83 | 26.3 | 26.22 | 27.85 | 26.25 | 25.5 | 26.0 | 25.5 |
| 23 | 26.8 | 26.9 | 26.9 | 26.17 | 25.83 | 26.3 | 26.18 | 27.15 | 25.8 | 25.5 | 25.8 | 25.4 |
| 24 | 26.75 | 26.82 | 26.9 | 26.15 | 25.83 | 26.28 | 26.18 | 26.45 | 25.9 | 25.5 | 26.1 | 25.4 |
| 25 | 26.65 | 26.6 | 26.85 | 26.0 | 25.83 | 26.28 | 28.1 | 27.15 | 27.8 | 25.5 | 25.8 | 25.4 |
| 26 | 26.55 | 26.75 | 26.6 | 26.97 | 25.83 | 26.25 | 28.45 | 26.8 | 27.25 | 25.5 | 25.8 | 25.4 |
| 27 | 26.5 | 26.6 | 26.42 | 25.95 | 25.83 | 26.25 | 28.32 | 26.6 | 26.4 | 25.5 | 29.15 | 25.4 |
| 28 | 26.45 | 26.65 | 26.32 | 25.95 | 25.82 | 26.3 | 26.95 | 26.1 | 26.15 | 25.5 | 29.3 | 25.4 |
| 29 | 26.45 | ....... | 26.3 | 26.2 | 25.82 | 26.25 | 26.5 | 25.85 | 26.1 | 25.5 | ....... | 25.4 |
| 30 | 26.45 | ....... | 26.82 | 26.41 | 25.82 | 26.28 | 26.5 | 25.75 | 25.9 | 25.5 | ....... | 25.4 |
| 31 | 26.4 | ....... | 26.75 | ....... | 25.82 | ....... | 26.3 | 25.85 | ....... | 25.5 | ....... | 25.4 |

NOTE.—Gage washed out by flood November 28.

*Daily discharge, in second-feet, of San Pedro River at Charleston, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 36 | 23 | 110 | 91 | 64 | 18 | 15 | ....... | 44 | 41 | 23 | ....... |
| 2 | 30 | 23 | 247 | 86 | 58 | 18 | 15 | ....... | 49 | 41 | 23 | ....... |
| 3 | 30 | 23 | 172 | 79 | 51 | 18 | 15 | ....... | 177 | 34 | 23 | ....... |
| 4 | 24 | 25 | 164 | 71 | 51 | 18 | 14 | ....... | 186 | 28 | 23 | ....... |
| 5 | 24 | 47 | 114 | 70 | 42 | 16 | 12 | ....... | 219 | 24 | 23 | ....... |
| 6 | 24 | 27 | 162 | 56 | 42 | 17 | 13 | ....... | 95 | 25 | 23 | ....... |
| 7 | 30 | 235 | 207 | 48 | 42 | 17 | 13 | ....... | 83 | 17 | 21 | ....... |
| 8 | 30 | 180 | 370 | 44 | 43 | 18 | 13 | ....... | 90 | 29 | 149 | ....... |
| 9 | 30 | 108 | 222 | 44 | 31 | 25 | 14 | 135 | 61 | 30 | 174 | ....... |
| 10 | 94 | 70 | 319 | 44 | 32 | 135 | 14 | 93 | 58 | 31 | 118 | ....... |
| 11 | 124 | 67 | 148 | 44 | 29 | 97 | 33 | 86 | 30 | 34 | 112 | ....... |
| 12 | 124 | 61 | 76 | 50 | 28 | 74 | 118 | 46 | 30 | 134 | 56 | ....... |
| 13 | 66 | 49 | 110 | 67 | 25 | 57 | 123 | 77 | 30 | 134 | 49 | ....... |
| 14 | 41 | 43 | 104 | 122 | 25 | 48 | 49 | 129 | 30 | 96 | 42 | ....... |
| 15 | 41 | 36 | 110 | 96 | 25 | 47 | 31 | 70 | 57 | 79 | 42 | ....... |
| 16 | 44 | 36 | 81 | 69 | 22 | 39 | 20 | 62 | 82 | 62 | 42 | ....... |
| 17 | 35 | 43 | 668 | 79 | 23 | 36 | 18 | 211 | 88 | 47 | 42 | 61 |
| 18 | 35 | 73 | 281 | 79 | 24 | 28 | 14 | 86 | 86 | 31 | 38 | 61 |
| 19 | 31 | 191 | 185 | 75 | 24 | 28 | 14 | 198 | 55 | 31 | 38 | 61 |
| 20 | 31 | 214 | 129 | 65 | 22 | 20 | 13 | 225 | 40 | 31 | 38 | 61 |
| 21 | 31 | 136 | 86 | 58 | 23 | 20 | 13 | 287 | 73 | 32 | 38 | 68 |
| 22 | 31 | 113 | 81 | 65 | 23 | 15 | 13 | 206 | 76 | 25 | 68 | 61 |
| 23 | 31 | 81 | 87 | 61 | 23 | 15 | 12 | 164 | 45 | 25 | 53 | 54 |
| 24 | 30 | 69 | 87 | 58 | 21 | 12 | 12 | 110 | 52 | 26 | 74 | 54 |
| 25 | 28 | 36 | 81 | 44 | 21 | 12 | 177 | 157 | 183 | 27 | 45 | 54 |
| 26 | 26 | 58 | 51 | 145 | 19 | 10 | 201 | 134 | 143 | 26 | 45 | 54 |
| 27 | 25 | 36 | 30 | 30 | 18 | 10 | 192 | 120 | 82 | 26 | 286 | 54 |
| 28 | 24 | 43 | 17 | 30 | 18 | 18 | 96 | 86 | 65 | 25 | 296 | 54 |
| 29 | 24 | ....... | 15 | 50 | 18 | 16 | 61 | 69 | 55 | 24 | ....... | 54 |
| 30 | 24 | ....... | 100 | 75 | 18 | 16 | 61 | 62 | 48 | 23 | ....... | 54 |
| 31 | 23 | ....... | 89 | ....... | 18 | ....... | 55 | 69 | ....... | 23 | ....... | 54 |

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly discharge of San Pedro River at Charleston, Ariz., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 124 | 23 | 39.4 | 2,423 |
| February | 235 | 23 | 76.6 | 4,254 |
| March | 668 | 15 | 152 | 9,346 |
| April | 145 | 30 | 66.5 | 3,957 |
| May | 64 | 18 | 29.8 | 1,832 |
| June | 135 | 10 | 30.6 | 1,821 |
| July | 201 | 12 | 47.2 | 2,902 |
| August (9-31) | 287 | 46 | 125 | 5,702 |
| September | 219 | 30 | 80.4 | 4,784 |
| October | 134 | 17 | 40.7 | 2,502 |
| November (1-28) | 296 | 21 | 71.6 | 3,976 |
| December (17-31) | 68 | 54 | 57.3 | 1,705 |
| The period | | | | 45,200 |

## SALT RIVER AT ROOSEVELT, ARIZ.

This station was established February 7, 1901. It is located at the town of Roosevelt, which is the United States Reclamation Service construction camp for the Salt River dam and reservoir, and is about 12 miles west of Livingston, Ariz. The gage rod and cable are at the upper end of the gorge, about 2,000 feet below the mouth of Tonto Creek and 1,500 feet above the dam site.

Discharge measurements are made by means of a car suspended from a cable.

The gage is a vertical rod fastened to the rocks on the left bank of the river.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 66, pp 99-100; 85, p 25; 100, p 42; 133, p 212.
Discharge: 66, p 100; 85, pp 26-27; 100, pp 42 43; 133, pp 212-213.
Discharge, mean daily: 133, p 214.
Discharge, monthly: 75, p 178; 85, p 29; 100, p 45; 133, p 214.
Gage heights: 66, p 100; 85, p 28; 100, p 44; 133, p 213.
Rating table: 85, p 28.

*Discharge measurements of Salt River at Roosevelt, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge | Date. | Hydrographer. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 4 | Osburn Richins | 21.00 | 30,360 | February 4 | Osburn Richins | 23.50 | [a]43,350 |
| January 4 | do | 20.50 | 26,680 | February 7 | do | 11.50 | [a]6,872 |
| January 4 | do | 23.50 | 38,530 | February 14 | do | 9.60 | 3,424 |
| January 4 | do | 16.00 | 16,200 | February 17 | do | 17.40 | [a]22,640 |
| January 7 | do | 11.50 | 6,107 | February 18 | do | 17.10 | 25,610 |
| January 10 | do | 11.50 | [a]3,189 | February 18 | do | 16.80 | [a]23,000 |
| January 11 | do | 15.80 | [a]12,600 | February 23 | do | 10.90 | [a]5,384 |
| January 13 | do | 10.00 | 4,528 | February 27 | do | 10.10 | [a]5,166 |
| January 18 | do | 8.10 | 742 | February 28 | do | 11.80 | 11,790 |
| January 21 | do | 8.10 | 751 | February 28 | do | 15.95 | [a]19,920 |
| January 27 | do | 7.70 | 554 | February 28 | do | 18.00 | [a]28,120 |
| February 4 | do | 16.00 | [a]18,220 | February 28 | do | 19.50 | [a]33,430 |
| February 4 | do | 21.00 | [a]34,160 | February 28 | do | 20.00 | [a]36,340 |
| February 4 | do | 20.50 | [a]30,020 | March 2 | do | 11.40 | [a]11,610 |

[a] Float measurement.

*Discharge measurements of Salt River at Roosevelt, Ariz., in 1905*—Continued.

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| March 10 | Osburn Richins | 11.55 | [a]10,060 |
| March 13 | do | 13.00 | [a]13,540 |
| March 14 | do | 20.50 | [a]40,520 |
| March 17 | do | 20.70 | [a]41,380 |
| March 18 | do | 19.70 | [a]39,850 |
| March 20 | do | 21.30 | [a]51,130 |
| March 24 | do | 10.50 | 11,000 |
| March 29 | do | 9.50 | 6,748 |
| April 4 | do | 13.70 | 14,600 |
| April 6 | do | 12.00 | 7,154 |
| April 10 | do | 12.40 | 7,908 |
| April 12 | Richins and Farish. | 23.50 | [a]43,560 |
| April 12 | do | 25.00 | [a]47,620 |
| April 13 | do | 20.00 | 40,230 |
| April 14 | do | 12.90 | 19,030 |
| April 15 | do | 11.80 | 13,370 |
| April 16 | do | 11.40 | 11,500 |
| April 18 | Osburn Richins | 10.00 | 8,875 |
| April 20 | do | 10.15 | 9,262 |
| April 22 | do | 9.60 | 8,335 |
| April 24 | do | 10.95 | 11,050 |
| April 25 | do | 11.85 | 13,920 |
| April 26 | do | 11.75 | 13,840 |
| April 27 | do | 11.10 | 11,470 |
| April 28 | do | 10.90 | 9,814 |
| May 1 | do | 10.50 | 9,524 |
| May 3 | do | 10.60 | 9,534 |
| May 4 | do | 10.20 | 8,390 |
| May 5 | do | 9.80 | 6,522 |
| May 6 | do | 9.30 | 5,811 |
| May 10 | do | 9.30 | 5,471 |
| May 11 | do | 9.00 | 5,606 |
| May 12 | do | 8.80 | 4,956 |
| May 13 | do | 8.60 | 4,269 |
| May 15 | Murphy and Richins. | 8.42 | 4,080 |
| May 17 | Osburn Richins | 8.40 | 4,026 |
| May 18 | do | 8.40 | 4,043 |
| May 19 | do | 8.45 | 4,155 |
| May 20 | do | 8.35 | 4,012 |
| May 22 | do | 7.90 | 3,299 |
| May 23 | do | 7.80 | 3,131 |
| May 24 | do | 7.65 | 2,846 |
| May 25 | do | 7.50 | 2,841 |
| May 27 | do | 7.30 | 2,420 |
| May 29 | do | 7.00 | 2,272 |
| May 31 | do | 6.70 | 1,921 |
| June 2 | do | 6.55 | 1,840 |
| June 5 | do | 6.70 | 1,957 |
| June 7 | do | 6.50 | 1,701 |
| June 8 | do | 6.60 | 1,881 |
| June 9 | do | 7.20 | 2,414 |
| June 10 | do | 7.10 | 2,275 |
| June 12 | Osburn Richins | 6.70 | 1,823 |
| June 13 | do | 6.50 | 1,762 |
| June 14 | do | 6.30 | 1,597 |
| June 16 | do | 6.10 | 1,378 |
| June 17 | do | 6.10 | 1,369 |
| June 19 | do | 5.85 | 1,256 |
| June 20 | do | 5.70 | 1,079 |
| June 21 | do | 5.60 | 938 |
| June 22 | do | 5.55 | 905 |
| June 23 | do | 5.45 | 877 |
| June 24 | do | 5.40 | 864 |
| June 26 | do | 5.30 | 808 |
| June 27 | do | 5.20 | 770 |
| June 28 | do | 5.15 | 733 |
| June 29 | do | 5.10 | 715 |
| June 30 | do | 5.05 | 687 |
| July 1 | do | 5.05 | 687 |
| July 7 | do | 4.60 | 455 |
| July 8 | do | 4.50 | 415 |
| July 10 | do | 4.40 | 374 |
| July 12 | do | 4.30 | 344 |
| July 13 | do | 4.40 | 358 |
| July 14 | do | 4.30 | 383 |
| July 15 | do | 4.30 | 337 |
| July 17 | do | 4.60 | 427 |
| July 18 | do | 4.50 | 400 |
| July 19 | do | 4.50 | 392 |
| July 20 | do | 4.35 | 363 |
| July 22 | do | 4.40 | 402 |
| July 24 | do | 4.50 | 406 |
| August 1 | do | 5.20 | 656 |
| August 2 | do | 5.00 | 603 |
| August 4 | do | 4.60 | 554 |
| August 5 | do | 4.40 | 522 |
| August 7 | do | 4.50 | 523 |
| August 8 | do | 4.30 | 490 |
| August 10 | do | 5.30 | 634 |
| August 11 | do | 5.90 | 736 |
| August 12 | do | 5.10 | 603 |
| August 14 | do | 4.90 | 536 |
| August 15 | do | 4.70 | 461 |
| August 17 | do | 4.80 | 471 |
| August 18 | do | 4.70 | 436 |
| August 19 | do | 4.50 | 391 |
| August 21 | do | 5.50 | 774 |
| August 22 | do | 4.70 | 452 |
| August 23 | do | 7.20 | 2,495 |
| August 25 | do | 6.70 | 1,578 |
| August 26 | do | 5.20 | 705 |
| August 28 | do | 5.00 | 527 |
| August 30 | do | 5.20 | 362 |
| August 31 | do | 5.10 | 337 |
| September 1 | do | 5.00 | 340 |
| September 2 | do | 5.30 | 574 |

[a] Float measurement.

*Discharge measurements of Salt River at Roosevelt, Ariz., in 1905*—Continued.

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| September 4 | Osburn Richins | 5.20 | 741 | November 8 | E. O. Blades | 6.60 | 2,045 |
| September 6 | do | 6.65 | 2,031 | November 9 | do | 5.40 | 1,292 |
| September 8 | do | 5.40 | 913 | November 10 | do | 5.00 | 791 |
| September 9 | do | 4.70 | 762 | November 11 | do | 4.80 | 715 |
| September 11 | do | 4.60 | 653 | November 13 | do | 4.50 | 638 |
| September 12 | do | 4.40 | 612 | November 14 | do | 4.40 | 587 |
| September 14 | do | 4.20 | 448 | November 15 | do | 4.30 | 510 |
| September 16 | do | 4.00 | 316 | November 16 | do | 4.20 | 539 |
| September 18 | do | 3.80 | 315 | November 17 | do | 4.20 | 524 |
| September 20 | do | 3.80 | 292 | November 18 | do | 4.15 | 491 |
| September 22 | do | 3.60 | 227 | November 20 | do | 4.10 | 471 |
| September 25 | do | 6.15 | 1,252 | November 21 | do | 4.15 | 484 |
| September 26 | do | 6.30 | 1,321 | November 22 | do | 6.75 | 3,168 |
| September 30 | do | 6.90 | 1,414 | November 23 | do | 6.55 | 2,230 |
| October 2 | do | 5.60 | 710 | November 24 | do | 6.75 | 2,660 |
| October 3 | do | 5.30 | 574 | November 25 | do | 6.50 | 1,827 |
| October 4 | do | 5.10 | 500 | December 5 | do | 7.65 | 2,497 |
| October 5 | do | 4.90 | 385 | December 6 | do | 7.55 | 2,347 |
| October 7 | do | 4.70 | 261 | December 7 | do | 7.45 | 1,993 |
| October 9 | do | 4.40 | 283 | December 8 | do | 7.35 | 1,762 |
| October 11 | do | 4.20 | 231 | December 9 | do | 7.30 | 1,561 |
| October 19 | do | 4.00 | 316 | December 11 | do | 7.10 | 1,341 |
| October 20 | do | 3.90 | 297 | December 12 | do | 7.10 | 1,276 |
| October 21 | do | 3.90 | 302 | December 13 | do | 7.00 | 1,149 |
| October 23 | Richins and Blades. | 3.90 | 300 | December 14 | do | 7.00 | 1,168 |
| | | | | December 15 | do | 6.90 | 1,091 |
| October 24 | do | 3.80 | 308 | December 16 | do | 6.90 | 981 |
| October 25 | do | 3.80 | 307 | December 18 | do | 6.80 | 888 |
| October 26 | E. O. Blades | 3.80 | 335 | December 19 | do | 6.80 | 869 |
| October 27 | do | 3.80 | 320 | December 20 | do | 6.80 | 865 |
| October 28 | do | 3.80 | 331 | December 21 | do | 7.00 | 1,041 |
| October 30 | do | 3.80 | 314 | December 22 | do | 7.00 | 1,213 |
| October 31 | do | 3.80 | 304 | December 23 | do | 6.95 | 945 |
| November 1 | do | 3.80 | 305 | December 26 | do | 6.60 | 697 |
| November 2 | do | 3.80 | 299 | December 27 | do | 6.70 | 829 |
| November 3 | do | 3.80 | 306 | December 28 | do | 6.80 | 887 |
| November 6 | do | 4.25 | 628 | December 29 | do | 6.80 | 945 |
| November 7 | do | 4.20 | 610 | | | | |

*Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.91 | 7.65 | 14.8 | 10.0 | 10.5 | 6.55 | 5.0 | 5.2 | 5.05 | 6.15 | 3.8 | 8.75 |
| 2 | 6.91 | 7.85 | 12.1 | 10.3 | 10.6 | 6.52 | 4.9 | 4.95 | 5.15 | 5.6 | 3.8 | 8.5 |
| 3 | 6.91 | 8.95 | 11.0 | 11.35 | 10.6 | 6.45 | 4.85 | 4.75 | 6.05 | 5.2 | 3.8 | 8.1 |
| 4 | 6.9 | 21.0 | 10.8 | 13.2 | 10.25 | 6.72 | 4.8 | 4.55 | 4.95 | 5.05 | 3.8 | 7.85 |
| 5 | 6.9 | 16.25 | 11.05 | 12.6 | 9.75 | 6.7 | 4.7 | 4.4 | 5.5 | 4.9 | 3.95 | 7.65 |
| 6 | 6.9 | 15.4 | 11.1 | 11.6 | 9.25 | 6.7 | 4.6 | 4.45 | 6.4 | 4.75 | 4.25 | 7.55 |
| 7 | 6.9 | 12.0 | 10.9 | 11.9 | 9.0 | 6.5 | 4.6 | 4.45 | 5.65 | 4.65 | 4.2 | 7.45 |
| 8 | 6.9 | 10.15 | 10.6 | 11.9 | 9.0 | 6.62 | 4.5 | 4.3 | 5.3 | 4.45 | 6.65 | 7.55 |
| 9 | 7.46 | 9.45 | 10.9 | 12.15 | 9.2 | 7.2 | 4.45 | 4.2 | 4.8 | 4.3 | 5.4 | 7.3 |
| 10 | 12.75 | 9.35 | 11.45 | 12.6 | 9.25 | 7.05 | 4.4 | 5.15 | 4.75 | 4.2 | 5.0 | 7.2 |
| 11 | 15.65 | 8.85 | 11.4 | 16.2 | 9.0 | 6.85 | 4.4 | 5.75 | 4.65 | 4.2 | 4.75 | 7.1 |
| 12 | 13.5 | 11.75 | 10.35 | 23.5 | 8.75 | 6.65 | 4.3 | 5.15 | 4.5 | 4.1 | 4.65 | 7.0 |

*Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 9.9 | 10.1 | 15.5 | 22.5 | 8.6 | 6.5 | 4.35 | 4.95 | 4.5 | 4.0 | 4.5 | 7.0 |
| 14 | 9.0 | 9.5 | 19.95 | 13.35 | 8.5 | 6.25 | 4.3 | 4.9 | 4.2 | 4.0 | 4.4 | 7.0 |
| 15 | 8.65 | 9.3 | 14.1 | 11.9 | 8.42 | 6.2 | 4.3 | 4.7 | 4.0 | 4.0 | 4.3 | 6.9 |
| 16 | 8.55 | 9.92 | 12.5 | 10.9 | 8.4 | 6.1 | 4.6 | 4.8 | 4.0 | 4.0 | 4.2 | 6.9 |
| 17 | 8.45 | 17.35 | 20.25 | 9.9 | 8.4 | 6.1 | 4.6 | 4.75 | 3.9 | 4.0 | 4.2 | 6.8 |
| 18 | 8.35 | 16.70 | 19.35 | 9.9 | 8.4 | 5.9 | 4.45 | 4.7 | 3.8 | 4.0 | 4.15 | 6.8 |
| 19 | 8.25 | 11.45 | 14.65 | 9.9 | 8.42 | 5.82 | 4.5 | 4.6 | 3.8 | 4.0 | 4.1 | 6.8 |
| 20 | 8.13 | 10.35 | 19.65 | 10.15 | 8.3 | 5.7 | 4.5 | 4.5 | 3.8 | 3.9 | 4.1 | 6.8 |
| 21 | 8.1 | 9.7 | 14.0 | 9.75 | 8.07 | 5.6 | 4.5 | 5.15 | 3.7 | 3.9 | 4.15 | 7.0 |
| 22 | 8.04 | 9.5 | 10.9 | 9.55 | 7.87 | 5.55 | 4.45 | 4.6 | 3.6 | 3.9 | 6.75 | 7.0 |
| 23 | 7.97 | 10.25 | 10.25 | 9.85 | 7.75 | 5.42 | 4.4 | 6.8 | 3.6 | 3.9 | 6.55 | 6.95 |
| 24 | 7.88 | 11.75 | 10.35 | 11.4 | 7.62 | 5.4 | 4.5 | 5.15 | 5.45 | 3.8 | 6.75 | 6.85 |
| 25 | 7.84 | 10.47 | 9.85 | 11.65 | 7.5 | 5.35 | 4.5 | 6.35 | 5.55 | 3.8 | 6.4 | 6.72 |
| 26 | 7.77 | 10.18 | 9.8 | 11.6 | 7.4 | 5.3 | 4.5 | 5.4 | 5.9 | 3.8 | 7.5 | 6.6 |
| 27 | 7.71 | 10.1 | 9.7 | 11.0 | 7.27 | 5.15 | 4.5 | 5.25 | 5.1 | 3.8 | 26.7 | 6.7 |
| 28 | 7.68 | 17.95 | 9.5 | 10.9 | 7.15 | 5.12 | 6.1 | 5.0 | 5.0 | 3.8 | 17.3 | 6.8 |
| 29 | 7.65 | ....... | 9.3 | 10.65 | 6.95 | 5.08 | 6.85 | 5.0 | 5.9 | 3.8 | 10.7 | 6.8 |
| 30 | 7.65 | ....... | 9.45 | 10.5 | 6.8 | 5.05 | 5.7 | 5.15 | 6.8 | 3.8 | 9.4 | 6.8 |
| 31 | 7.65 | ....... | 9.8 | ....... | 6.7 | ....... | 5.1 | 5.05 | ....... | 3.8 | ....... | 6.8 |

*Daily discharge, in second-feet, of Salt River at Roosevelt, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 172 | 526 | 17,100 | 7,548 | 9,350 | 1,800 | 650 | 655 | 380 | 1,132 | 313 | 8,700 |
| 2 | 172 | 625 | 12,150 | 8,076 | 9,700 | 1,770 | 600 | 590 | 460 | 710 | 313 | 4,700 |
| 3 | 172 | 3,900 | 9,250 | 9,819 | 9,700 | 1,700 | 575 | 572 | 1,497 | 527 | 313 | 3,670 |
| 4 | 165 | 31,400 | 8,925 | 12,020 | 8,475 | 1,970 | 550 | 545 | 526 | 480 | 313 | 3,020 |
| 5 | 165 | 18,800 | 11,300 | 8,937 | 6,738 | 1,950 | 500 | 522 | 1,000 | 385 | 420 | 2,497 |
| 6 | 165 | 16,700 | 11,330 | 6,495 | 5,675 | 1,950 | 455 | 523 | 1,806 | 310 | 628 | 2,347 |
| 7 | 165 | 8,250 | 11,220 | 6,989 | 5,175 | 1,750 | 455 | 515 | 1,136 | 250 | 610 | 1,993 |
| 8 | 165 | 4,500 | 11,060 | 6,989 | 5,175 | 1,870 | 415 | 490 | 891 | 250 | 2,210 | 1,762 |
| 9 | 346 | 3,145 | 11,220 | 7,437 | 5,575 | 2,450 | 395 | 475 | 783 | 260 | 1,292 | 1,561 |
| 10 | 5,900 | 2,959 | 11,540 | 8,937 | 5,675 | 2,300 | 375 | 612 | 772 | 230 | 790 | 1,451 |
| 11 | 12,300 | 2,037 | 11,500 | 20,040 | 5,175 | 2,100 | 275 | 705 | 707 | 230 | 695 | 1,341 |
| 12 | 9,460 | 8,306 | 8,200 | 43,350 | 4,675 | 1,900 | 345 | 612 | 632 | 217 | 67[illegible] | 1,158 |
| 13 | 4,000 | 4,400 | 22,050 | 45,470 | 4,375 | 1,750 | 358 | 547 | 632 | 231 | 638 | 1,158 |
| 14 | 2,400 | 3,238 | 38,700 | 20,370 | 4,200 | 1,500 | 335 | 530 | 448 | 245 | 587 | 1,158 |
| 15 | 1,685 | 2,867 | 17,600 | 14,010 | 4,060 | 1,450 | 335 | 461 | 316 | 259 | 510 | 1,091 |
| 16 | 1,513 | 4,040 | 12,150 | 10,620 | 4,025 | 1,350 | 427 | 471 | 316 | 274 | 539 | 981 |
| 17 | 1,341 | 21,550 | 39,800 | 8,864 | 4,025 | 1,350 | 427 | 450 | 310 | 298 | 524 | 935 |
| 18 | 1,170 | 20,450 | 36,550 | 8,864 | 4,025 | 1,150 | 378 | 436 | 303 | 302 | 491 | 888 |
| 19 | 999 | 7,000 | 23,200 | 8,864 | 4,060 | 1,086 | 392 | 413 | 303 | 316 | 471 | 867 |
| 20 | 828 | 4,800 | 44,400 | 9,303 | 3,850 | 1,000 | 392 | 390 | 303 | 300 | 471 | 867 |
| 21 | 743 | 3,614 | 23,440 | 8,601 | 3,455 | 950 | 392 | 625 | 265 | 300 | 484 | 1,041 |
| 22 | 715 | 3,238 | 11,940 | 8,250 | 3,159 | 925 | 403 | 427 | 227 | 300 | 3,168 | 1,213 |
| 23 | 682 | 4,250 | 9,524 | 8,777 | 3,012 | 860 | 402 | 1,864 | 227 | 300 | 2,230 | 945 |
| 24 | 640 | 7,700 | 9,895 | 11,500 | 2,870 | 850 | 406 | 625 | 970 | 313 | 2,660 | 860 |
| 25 | 620 | 4,990 | 8,040 | 12,750 | 2,750 | 825 | 406 | 1,327 | 1,010 | 313 | 1,755 | 765 |
| 26 | 588 | 4,560 | 7,855 | 12,500 | 2,650 | 800 | 406 | 803 | 1,150 | 313 | 2,150 | 697 |
| 27 | 560 | 4,400 | 7,481 | 11,160 | 2,520 | 725 | 406 | 680 | 830 | 313 | 97,710 | 829 |
| 28 | 546 | 27,550 | 6,742 | 10,800 | 2,400 | 712 | 1,300 | 527 | 790 | 313 | 45,250 | 887 |
| 29 | 526 | ....... | 6,000 | 9,906 | 2,200 | 690 | 2,000 | 527 | 1,150 | 313 | 14,050 | 945 |
| 30 | 526 | ....... | 6,700 | 9,370 | 2,050 | 675 | 935 | 350 | 1,515 | 313 | 9,480 | 915 |
| 31 | 526 | ....... | 7,300 | ....... | 1,950 | ....... | 617 | 325 | ....... | 313 | ....... | 945 |

**Note.**—Daily discharge obtained by indirect method.

*Estimated monthly discharge of Salt River at Roosevelt, Ariz., for 1905.*

[Drainage area, 5,756 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 12,300 | 165 | 1,611 | 99,060 | 0.280 | 0.323 |
| February | 31,400 | 526 | 8,207 | 455,800 | 1.43 | 1.49 |
| March | 44,400 | 6,000 | 15,300 | 940,800 | 2.66 | 3.07 |
| April | 45,470 | 6,495 | 12,550 | 746,800 | 2.18 | 2.43 |
| May | 9,700 | 1,950 | 4,604 | 283,100 | .800 | .922 |
| June | 2,450 | 675 | 1,405 | 83,600 | .244 | .272 |
| July | 2,000 | 335 | 529 | 32,530 | .092 | .106 |
| August | 1,864 | 325 | 600 | 36,890 | .104 | .120 |
| September | 1,497 | 227 | 722 | 42,960 | .125 | .140 |
| October | 1,132 | 217 | 342 | 21,030 | .059 | .068 |
| November | 97,710 | 313 | 6,391 | 380,300 | 1.11 | 1.24 |
| December | 8,700 | 697 | 1,684 | 103,600 | .293 | .338 |
| The year | 97,710 | 217 | 4,495 | 3,226,000 | .781 | 10.52 |

## SALT RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located one-third mile above the junction of Salt and Verde rivers, 30 miles northeast of Phoenix, 15 miles northeast of Mesa, and 1¾ miles above the Arizona canal diversion dam.

The channel is straight for about 500 feet above the station. The right bank is about 3½ feet high at the water's edge and rises with a gradual slope for 400 feet; it is clean and is subject to overflow. The left bank rises vertically for about 5 feet, at which point there is a small bench, from which the rocks rise to a considerable height; this bank is clean and does not overflow. The bed of the stream is composed of sand and is shifting, and it is necessary to make a large number of measurements in order to obtain an accurate estimate of the discharge. The current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is 120 feet south of the standard under the cable at the north bank. Low-water measurements are made by wading about 1,000 feet upstream from the cable, where a tag wire has been placed.

Gage heights and measurements are taken by W. Richins, who devotes his whole time to the work. There have been five gages in use at this station, as follows:

Gage No. 1, set April 20, 1897, was a 2- by 6-inch timber bolted to the rocks on the south bank of the river, about one-fourth mile above the cable. This gage, which has since been removed, was used until November 30, 1899, when the station was temporarily abandoned. The bench mark is a nail in a palo verde tree about 75 feet west of the cable anchorage on the north bank; elevation, 17.33 feet above the zero of the gage.

Gage No. 2 was established in 1901. It consists of a 2- by 6-inch timber fastened to a tree on the north bank of the river three-fourths mile above the cable. The zero of this gage is 1,323.54 feet above sea level. Its bench mark is a nail in a root of a willow tree, to which the gage is fastened; elevation, 1,328.69 feet above sea level, and 5.10 feet above the zero of the gage. On April 2, 1903, high water in Verde River backed up the water on gage No. 2 and changed the cross section by depositing sand.

Gage No. 3 was installed May 19, 1903. It consists of a 1- by 6-inch stadia rod spiked to a 2- by 4-inch timber and fastened to a tree on the south bank 1⅓ miles above the cable. The water surface at this gage is about 15 feet higher than at the mouth of the Verde River, and the zero of the gage is 1,336.27 feet above sea level. Three bench marks have been established for this gage, as follows: (1) A nail in a mesquite stump 200 feet east of Peters's corral; elevation, 1,363.2 feet above sea level and 26.93 feet above the zero of the gage. (2) A nail in the root of a mesquite tree on top of the bank 50 feet northwest of the northwest corner of Peters's corral and about 75 feet from the gage; elevation, 1,356 feet above sea level and 19.73 feet above the zero of the gage. (3) A nail in the willow tree to which the gage is attached; elevation, 1,344.27 feet above sea level and 8.00 feet above the zero of the gage.

Gage No. 4 was a temporary gage on the north side of the river about 600 yards above the section and was read in conjunction with gage No. 3. This temporary gage, No. 4, was washed out by heavy floods early in 1905.

Gage No. 5 was established because of the difficulty and time involved in reaching gage No. 3 during high water and also because the river had changed its channel in such a way as to leave gage No. 3 dry. It was located on the right bank of the river about one-fourth mile below the location of No. 3. No. 5 was read from March 10, the date of its establishment, to March 20, 1905, on which date it was destroyed.

The river swept back to gage No. 3, which was used until April 14, when another change of channel rendered No. 3 useless. A temporary gage was then established at the old location of No. 4. This was observed until September 1, 1905, when a permanent gage was established. The zero of this gage is at an elevation of 1,326.62 feet above sea level and is referred to two bench marks: (1) On a mesquite tree 200 feet northwest of the gage; elevation, 1,346.12 feet above sea level. (2) A nail in tree at gage; elevation, 1,336.37 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 418-419, 420-421; WS 16, p 148; 28, p 133; 38, p 321; 50, pp 386-387; 66, p 101; 85, pp 23-24; 100, pp 36-37; 133, pp 215-216.
Discharge: Ann 19, iv, p 419; WS 16, p 148; 28, p 143; 38, p 321; 66, p 102; 85, p 24; 100, pp 38-39; 133, pp 215-216.
Discharge, mean daily: WS 133, p 220.
Discharge, monthly: Ann 20, iv, p 406; 21, iv, p 386; WS 75, p 179; 85, p 25; 100, pp 40-41; 133, p 221.
Discharge, yearly: Ann 20, iv, p 59.
Gage heights: WS 16, p 149; 28, p 140; 38, p 322; 66, p 102; 85, p 25; 100, p 40; 133, p 219.
Hydrographs: Ann 19, iv, p 423; 20, iv, p 406; 21, iv, p 387.
Rating tables: Ann 19, iv, p 419; WS 28, p 145; 100 pp 40-41.

*Discharge measurements of Salt River at McDowell, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 11 | W. Richins | 9.30 | 18,500 | March 11 | W. Richins | 5.68 | 9,961 |
| January 13 | do | 5.25 | 5,134 | March 14 | do | 10.20 | [a]29,040 |
| January 16 | do | 3.25 | 1,235 | March 17 | do | 11.20 | [a]37,970 |
| January 20 | do | 2.95 | 1,110 | March 29 | do | 6.05 | 6,385 |
| January 24 | do | 2.44 | 569 | March 31 | do | 6.00 | 6,441 |
| January 27 | do | 2.37 | 477 | April 4 | do | 6.55 | 7,657 |
| January 31 | do | 2.32 | 439 | April 5 | do | 6.55 | 9,070 |
| February 3 | do | 3.70 | 1,474 | April 12 | do | 10.60 | 60,570 |
| February 4 | do | 12.10 | [a]43,280 | April 13 | do | 10.20 | 54,190 |
| February 7 | do | 7.95 | 13,890 | April 14 | do | | 21,840 |
| February 10 | do | 5.00 | 4,797 | April 19 | do | 4.40 | 9,756 |
| February 14 | do | 4.83 | 4,464 | April 21 | do | 4.30 | 9,667 |
| February 17 | do | 9.50 | 25,560 | April 25 | do | 5.20 | 15,990 |
| February 21 | do | 5.00 | 6,207 | April 28 | do | 4.50 | 11,920 |
| February 24 | do | 6.75 | 10,150 | May 2 | do | 4.35 | 10,680 |
| March 1 | do | 8.65 | 24,780 | May 5 | do | 3.65 | 8,173 |
| March 8 | do | 5.40 | [b]8,406 | May 10 | do | 3.42 | 7,427 |

[a] Flat measurement.

[b] Gage height of new gage No. 4—5.9.

*Discharge measurements of Salt River at McDowell, Ariz., in 1905*—Continued.

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| May 12 | W. Richins | 2.92 | 5,604 | July 29 | W. Richins | −0.35 | 874 |
| May 16 | do | 2.50 | 4,329 | August 1 | do | − .26 | 752 |
| May 19 | do | 2.40 | 4,243 | August 3 | do | − .05 | 546 |
| May 23 | do | 1.85 | 3,327 | August 5 | do | − .04 | 493 |
| May 24 | do | 1.75 | 3,149 | August 8 | do | − .06 | 463 |
| May 26 | do | 1.57 | 2,889 | August 10 | do | − .08 | 557 |
| May 30 | do | 1.30 | 2,228 | August 16 | do | − .20 | 445 |
| May 31 | do | 1.25 | 2,066 | August 22 | do | − .05 | 507 |
| June 2 | do | 1.20 | 1,848 | August 24 | do | .50 | 1,098 |
| June 6 | do | 1.28 | 1,888 | August 29 | do | − .10 | 457 |
| June 7 | do | 1.20 | 1,838 | August 31 | do | − .28 | 354 |
| June 9 | do | 1.77 | 2,859 | September 2 | do | 5.03 | [a] 1,815 |
| June 12 | do | 1.25 | 2,077 | September 5 | do | 4.25 | 781 |
| June 13 | do | 1.12 | 1,861 | September 7 | do | 5.18 | 1,993 |
| June 14 | do | .92 | 1,600 | September 9 | do | 4.30 | 842 |
| June 15 | do | .83 | 1,683 | September 12 | do | 4.03 | 640 |
| June 16 | do | .80 | 1,532 | September 15 | do | 3.80 | 458 |
| June 17 | do | .78 | 1,336 | September 19 | do | 3.56 | 330 |
| June 19 | do | .65 | 1,210 | September 21 | do | 3.50 | 302 |
| June 20 | do | .63 | 1,155 | September 23 | do | 3.45 | 266 |
| June 21 | do | .60 | 1,081 | September 26 | do | 4.90 | 1,614 |
| June 22 | do | .55 | 1,000 | September 30 | do | 5.15 | 1,995 |
| June 23 | do | .49 | 968 | October 4 | do | 4.14 | 718 |
| June 24 | do | .45 | 860 | October 7 | do | 3.88 | 477 |
| June 26 | do | .42 | 819 | October 10 | do | 3.70 | 374 |
| June 27 | do | .39 | 776 | October 12 | do | 3.63 | 339 |
| June 28 | do | .37 | 791 | October 14 | do | 3.60 | 350 |
| June 29 | do | .35 | 716 | October 17 | do | 3.55 | 315 |
| June 30 | do | .31 | 676 | October 19 | do | 3.52 | 311 |
| July 1 | do | .29 | 684 | October 21 | do | 3.50 | 289 |
| July 3 | do | .18 | 575 | October 26 | do | 3.52 | 297 |
| July 4 | do | .16 | 526 | October 28 | do | 3.52 | 302 |
| July 5 | do | .12 | 521 | October 31 | do | 3.50 | 284 |
| July 6 | do | .08 | 496 | November 2 | do | 3.47 | 300 |
| July 7 | do | .02 | 460 | November 4 | do | 3.50 | 308 |
| July 8 | do | −.04 | 459 | November 7 | do | 3.90 | 515 |
| July 11 | do | −.17 | 368 | November 9 | do | 5.25 | 1,843 |
| July 13 | do | −.26 | 345 | November 11 | do | 4.12 | 665 |
| July 15 | do | −.02 | 481 | November 14 | do | 4.02 | 534 |
| July 18 | do | −.12 | 428 | November 16 | do | 3.90 | 495 |
| July 20 | do | −.24 | 370 | November 18 | do | 3.84 | 460 |
| July 22 | do | −.25 | 355 | November 22 | do | 4.50 | 1,045 |
| July 25 | do | −.13 | 445 | November 24 | do | 5.25 | 2,219 |
| July 27 | do | −.17 | 415 | | | | |

[a] Gage readings are from rod No. 4. Four feet on this rod is the same as zero on the other. All subsequent readings are from this rod.

### *Daily gage height, in feet, of Salt River at McDowell, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.82 | 2.32 | 9.5 | 5.9 | 4.2 | 1.2 | 0.28 | 0.25 | 3.68 | [a] 4.9 | 3.47 | [b] 6.8 |
| 2 | 1.82 | 2.32 | 6.65 | 6.35 | 4.35 | 1.2 | .25 | .15 | 5.05 | [a] 4.62 | 3.47 | 6.57 |
| 3 | 1.82 | 3.8 | 6.05 | 6.0 | 4.3 | 1.2 | .2 | .03 | [a] 4.0 | 4.22 | 3.47 | 6.3 |
| 4 | 1.82 | 10.25 | 5.25 | 6.85 | 4.05 | 1.25 | .16 | .09 | 4.47 | 4.12 | 3.5 | 6.1 |
| 5 | 1.82 | 10.9 | 5.2 | 6.55 | 3.65 | 1.32 | .11 | −.04 | 4.52 | 4.02 | [a] 3.66 | 6.3 |
| 6 | 1.81 | 9.15 | 5.35 | 6.2 | 3.3 | 1.26 | .06 | −.05 | 4.33 | 3.94 | 3.76 | 6.15 |
| 7 | 1.8 | 8.05 | 5.23 | 6.2 | 3.35 | 1.2 | .02 | −.05 | 5.05 | 3.86 | 3.92 | 6.09 |
| 8 | 1.82 | 6.6 | 5.07 | 6.05 | 3.4 | 1.18 | −.05 | −.08 | 4.55 | [a] 3.8 | 4.75 | 5.92 |
| 9 | 1.85 | 5.85 | 4.95 | 5.85 | 3.2 | 1.72 | −.09 | −.05 | 4.3 | 3.75 | 5.12 | 5.85 |
| 10 | 8.9 | 5.15 | 5.75 | 5.9 | 3.37 | 1.5 | −.14 | +.06 | [a] 4.12 | 3.68 | 4.32 | 5.68 |
| 11 | 9.3 | 5.05 | 5.85 | 5.35 | 3.15 | 1.5 | −.18 | +.03 | 4.03 | 3.64 | 4.12 | 5.62 |
| 12 | 7.35 | 5.7 | 4.57 | 10.3 | 2.87 | 1.28 | −.24 | .24 | 4.01 | 3.62 | [a] 4.1 | 5.56 |
| 13 | 5.2 | 5.5 | 6.18 | 10.6 | 2.75 | 1.12 | −.14 | .03 | 3.92 | 3.6 | 4.08 | 5.5 |
| 14 | 3.85 | 4.8 | 10.1 | 6.75 | 2.7 | .96 | −.23 | −.03 | 3.85 | 3.6 | 4.01 | 5.4 |
| 15 | 3.2 | 4.25 | 7.62 | 5.6 | 2.5 | .84 | −.01 | −.14 | 3.77 | [a] 3.58 | 3.94 | 5.36 |
| 16 | 3.2 | 4.7 | 5.78 | 4.95 | 2.45 | .81 | −.03 | −.21 | 3.74 | 3.56 | 3.89 | 5.32 |
| 17 | 3.1 | 9.2 | 10.85 | 4.85 | 2.42 | .78 | −.08 | −.22 | [a] 3.67 | 3.54 | 3.87 | [a] 5.25 |
| 18 | 3.2 | 9.65 | 10.85 | 4.6 | 2.45 | .67 | −.14 | −.26 | 3.6 | 3.53 | 3.84 | 5.22 |
| 19 | 3.15 | 7.6 | 9.3 | 4.35 | 2.38 | .68 | −.2 | −.23 | 3.54 | 3.52 | [a] 3.82 | 5.14 |
| 20 | 2.95 | 6.1 | 10.0 | 4.5 | 2.3 | .62 | −.26 | −.22 | 3.52 | 3.51 | 3.81 | 5.1 |
| 21 | 2.9 | 4.9 | 9.25 | 4.25 | 2.25 | .58 | −.3 | −.21 | 3.49 | 3.5 | 3.88 | 5.46 |
| 22 | 2.78 | 4.1 | 8.25 | 3.9 | 2.0 | .54 | −.25 | −.03 | 3.46 | [a] 3.53 | 4.95 | 5.68 |
| 23 | 2.6 | 4.35 | 7.4 | 3.85 | 1.82 | .48 | −.22 | .58 | 3.45 | 3.53 | 5.5 | 5.52 |
| 24 | 2.44 | 6.45 | 6.82 | 4.7 | 1.72 | .44 | −.15 | .50 | [a] 5.9 | 3.53 | 5.2 | [a] 5.35 |
| 25 | 2.41 | 5.8 | 6.51 | 5.1 | 1.65 | .42 | −.14 | .35 | 5.0 | 3.52 | 5.4 | 5.1 |
| 26 | 2.38 | 5.45 | 6.4 | 5.1 | 1.58 | .42 | −.13 | .4 | 5.02 | 3.51 | [b] 6.0 | 5.1 |
| 27 | 2.37 | 4.45 | 6.35 | 4.6 | 1.45 | .38 | −.19 | .18 | 4.32 | 3.5 | [b] 21.2 | 5.0 |
| 28 | 2.37 | 8.65 | 6.33 | 4.5 | 1.43 | .36 | +.32 | .05 | 4.03 | 3.52 | [b] 15.0 | 5.02 |
| 29 | 2.35 | ....... | 6.13 | 4.3 | 1.38 | .33 | .35 | −.12 | 3.97 | [a] 3.5 | [b] 10.0 | 5.04 |
| 30 | 2.34 | ....... | 5.75 | 4.2 | 1.28 | .3 | 1.5 | −.23 | [a] 5.32 | 3.5 | [b] 7.5 | 5.05 |
| 31 | 2.32 | ....... | 5.95 | ....... | 1.25 | ....... | .63 | −.28 | ....... | 3.49 | ....... | 5.0 |

[a] Interpolated gage heights.
[b] Approximate flood heights during time gage was out.

NOTE.—Several gages used during the year. See station description.

### *Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 184 | 527 | 29,060 | 5,678 | 10,140 | 2,020 | 660 | 735 | 380 | 1,635 | 275 | 6,000 |
| 2 | 184 | 527 | 14,700 | 8,026 | 10,760 | 2,020 | 630 | 635 | 1,838 | 1,262 | 275 | 5,160 |
| 3 | 184 | 1,576 | 11,680 | 6,200 | 10,560 | 2,020 | 580 | 530 | 595 | 764 | 275 | 4,170 |
| 4 | 184 | 26,860 | 7,651 | 10,636 | 9,579 | 2,200 | 552 | 575 | 1,061 | 685 | 290 | 3,430 |
| 5 | 184 | 32,320 | 7,399 | 9,070 | 8,192 | 2,237 | 517 | 493 | 1,127 | 610 | 370 | 4,170 |
| 6 | 177 | 17,870 | 8,154 | 7,244 | 6,976 | 2,128 | 486 | 475 | 879 | 550 | 426 | 3,600 |
| 7 | 170 | 14,280 | 7,530 | 7,244 | 7,155 | 2,020 | 462 | 475 | 1,838 | 492 | 535 | 3,350 |
| 8 | 184 | 9,544 | 6,745 | 6,460 | 7,323 | 1,984 | 420 | 450 | 1,168 | 450 | 1,438 | 2,750 |
| 9 | 205 | 7,095 | 6,140 | 5,417 | 6,629 | 2,977 | 396 | 515 | 840 | 420 | 1,936 | 2,500 |
| 10 | 17,050 | 3,882 | 11,720 | 5,678 | 7,219 | 2,570 | 376 | 685 | 685 | 380 | 970 | 1,815 |
| 11 | 18,870 | 3,632 | 12,100 | 4,366 | 6,457 | 2,570 | 362 | 650 | 617 | 360 | 665 | 1,625 |
| 12 | 11,990 | 6,606 | 7,121 | 55,080 | 5,484 | 2,164 | 351 | 895 | 602 | 350 | 670 | 1,540 |
| 13 | 5,008 | 5,953 | 13,390 | 60,600 | 5,093 | 1,876 | 376 | 640 | 535 | 340 | 655 | 1,480 |
| 14 | 1,663 | 3,006 | 28,650 | 22,720 | 4,945 | 1,616 | 352 | 570 | 485 | 340 | 534 | 1,380 |

*Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 1,132 | 2,626 | 19,000 | 17,850 | 4,430 | 1,430 | 483 | 485 | 432 | 330 | 490 | 1,340 |
| 16 | 1,132 | 3,755 | 11,830 | 14,420 | 4,335 | 1,385 | 475 | 440 | 414 | 320 | 490 | 1,300 |
| 17 | 1,063 | 24,650 | 34,850 | 13,760 | 4,278 | 1,340 | 445 | 425 | 365 | 310 | 490 | 1,228 |
| 18 | 1,132 | 26,630 | 34,850 | 12,100 | 4,335 | 1,178 | 410 | 400 | 340 | 305 | 445 | 1,195 |
| 19 | 1,097 | 17,620 | 25,540 | 10,760 | 4,202 | 1,192 | 390 | 415 | 310 | 300 | 455 | 1,120 |
| 20 | 959 | 11,040 | 28,260 | 11,530 | 4,050 | 1,108 | 365 | 415 | 300 | 295 | 450 | 1,075 |
| 21 | 926 | 5,768 | 35,800 | 10,350 | 3,958 | 1,050 | 350 | 415 | 285 | 290 | 505 | 1,440 |
| 22 | 843 | 2,250 | 17,940 | 9,058 | 3,495 | 990 | 355 | 565 | 270 | 305 | 975 | 1,820 |
| 23 | 720 | 3,354 | 13,510 | 8,884 | 3,162 | 904 | 377 | 1,180 | 265 | 305 | 3,176 | 1,495 |
| 24 | 609 | 9,471 | 10,480 | 12,760 | 2,977 | 852 | 425 | 1,100 | 4,220 | 305 | 2,060 | 1,330 |
| 25 | 589 | 8,008 | 8,861 | 15,420 | 2,847 | 826 | 440 | 860 | 1,770 | 300 | 2,903 | 1,075 |
| 26 | 568 | 7,220 | 8,287 | 15,420 | 2,718 | 826 | 440 | 920 | 1,797 | 295 | 4,545 | 1,075 |
| 27 | 561 | 3,792 | 8,027 | 12,100 | 2,477 | 776 | 395 | 660 | 866 | 290 | 138,000 | 975 |
| 28 | 561 | 24,780 | 7,922 | 11,530 | 2,441 | 752 | 830 | 550 | 610 | 300 | 83,530 | 990 |
| 29 | 547 | ....... | 6,878 | 10,560 | 2,348 | 716 | 874 | 445 | 580 | 290 | 33,100 | 1,020 |
| 30 | 541 | ....... | 5,066 | 10,140 | 2,164 | 680 | 2,780 | 375 | 2,430 | 290 | 17,710 | 1,030 |
| 31 | 527 | ....... | 5,939 | ....... | 2,110 | ....... | 1,260 | 355 | ....... | 285 | ....... | 975 |

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly dischagre of Salt River at McDowell, Ariz., for 1905.*

[Drainage area, 6,260 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 18,870 | 170 | 2,250 | 138,300 | 0.359 | 0.414 |
| February | 32,320 | 527 | 10,170 | 564,800 | 1.62 | 1.69 |
| March | 35,800 | 5,066 | 14,680 | 902,600 | 2.35 | 2.71 |
| April | 60,600 | 4,366 | 13,700 | 815,200 | 2.19 | 2.44 |
| May | 10,760 | 2,110 | 5,253 | 323,000 | .839 | .967 |
| June | 2,977 | 680 | 1,547 | 92,050 | .247 | .276 |
| July | 2,780 | 350 | 568 | 34,920 | .091 | .105 |
| August | 1,180 | 355 | 591 | 36,340 | .094 | .108 |
| September | 4,220 | 265 | 930 | 55,340 | .149 | .166 |
| October | 1,635 | 285 | 444 | 27,300 | .071 | .082 |
| November | 138,000 | 275 | 9,954 | 592,300 | 1.59 | 1.77 |
| December | 6,000 | 975 | 2,047 | 125,900 | .327 | .377 |
| The year | 138,000 | 170 | 5,178 | 3,708,000 | .827 | 11.10 |

## VERDE RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located 30 miles northeast of Phoenix, 15 miles northeast of Mesa, 2⅛ miles above the Arizona Canal diversion dam, and three-fourths mile above the mouth of the river.

The channel is straight for 300 feet above and below the station, with a width of 100 feet at low water and 450 feet at high water. The right bank is high, rocky, and clean, and is not subject to overflow; the left bank is low, clean, and is lbiale to overflow. The bed of the stream is composed of sand and is shifting. The current is swift.

Discharge measurements are made by means of a cable, car, and tagged wire. At low water the channel is oblique to the gaging section and measurements are made by wading at a point 400 feet above the cable.

Gage heights are observed by W. Richins. Three gages have been in use at this station, as follows:

Gage No. 1, established April 20, 1897, consisted of a vertical rod attached to a large cottonwood tree on the east bank about 60 feet below the cable. This was read until November 11, 1899, when the station was temporarily abandoned. The bench mark is a point on a cat's claw (acacia) tree about 100 feet southeast of the gage; elevation, 27.02 feet above the zero of the gage.

Gage No. 2 was established in January, 1901, and observations were resumed. It is an inclined 2- by 4-inch timber, fastened to the rocks on the west bank about 500 feet above the cable, the zero of the gage being 1,325.4 feet above sea level. Three bench marks were established for this gage, as follows: (1) A nail in a mesquite tree about 6 feet below the cable anchorage on the east bank; elevation, 1,345.5 feet above sea level, and 20.10 feet above the zero of the gage. (2) A nail in the cable standard at the east bank; elevation, 1,341.3 feet above sea level, and 15.90 feet above the zero of the gage. (3) A mark on rock at the gage; elevation, 1,330.4 feet above sea level, and 5.00 feet above the zero of the gage.

Gage No. 3 was established May 16, 1904, on account of water piling up at No. 2 during flood. It is a vertical rod fastened to a willow tree on the east bank about one-half mile above the cable. The zero of the gage is 1,339.26 feet above sea level. Two bench marks were established for this gage: (1) A nail in a large cottonwood tree on the top of the east bank near the gage; elevation, 1,354.11 feet above sea level, 14.85 feet above the zero of the gage. (2) A nail in the willow tree to which the gage is attached; elevation, 1,347.26 feet above sea level, and 8.00 feet above the zero of the gage.

Gage No. 3, with the tree to which it was attached, was washed out during the heavy flood February 25, 1905. As the water showed no tendency to pile up at Gage No. 2, readings were resumed on that gage, which was used to the end of the year.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report, Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 19, iv, pp 420-421; Bull 131, p 49; WS 16, p 150, 28 p 133; 38, p 323; 50 p 387; 66, pp 102-103, 85, p 21; 100, pp 31-32; 133, pp 222-223.

Discharge: WS 16, p 150; 38, p 323, 66, p 103; 85, p 22; 100, pp 33-34, 133, pp 223-226.

Discharge, mean daily: WS 133, p 227.

Discharge, monthly: Ann 11, ii, p 100; 19, iv, p 423; 20, iv, p 407, 21, iv, p 387; WS 75, p 177; 100, p 36; 133, p 227.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 131, p 51; WS 16, p 150; 28, pp 141,143; 38 p 324; 66, p 103; 85, p 23; 100, p 35; 133, p 226.

Hydrographs: Ann 19, iv, p 423; 20, iv, p 407; 21, iv, p 388; WS 75, p 177.

Rating table: Ann 19, iv, p 422.

*Discharge measurements of Verde River at McDowell, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 11 | W. Richins | 7.00 | 9,159 | February 14 | W. Richins | 3.90 | [a] 1,648 |
| January 13 | do | 3.70 | 2,183 | February 17 | do | 7.60 | [a] 8,174 |
| January 16 | do | 2.65 | 876 | February 21 | do | 5.90 | 4,195 |
| January 20 | do | 2.62 | 739 | February 24 | do | 9.70 | 11,670 |
| January 24 | do | 2.30 | 612 | March 1 | do | 14.5 | 23,280 |
| January 27 | do | 2.25 | 580 | March 6 | do | 8.75 | 5,433 |
| January 31 | do | 2.18 | 462 | March 11 | do | 6.95 | 2,617 |
| February 4 | do | 13.20 | 32,990 | March 14 [a] | do | 16.0 | 28,850 |
| February 7 | do | 7.75 | 7,921 | March 17 [a] | do | 17.0 | 31,090 |
| February 10 | do | 4.60 | 2,706 | March 29 | do | 7.75 | 2,973 |

[a] Float measurement.

*Discharge measurements of Verde River at McDowell, Ariz., in 1905*—Continued.

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| March 31 | W. Richins | 7.00 | 1,954 |
| April 4 | do | 6.70 | 1,341 |
| April 5 | Parish and Richins. | 6.6 | 1,363 |
| April 5 | do | 6.6 | 1,393 |
| April 6 | do | 6.65 | 1,383 |
| April 6 | do | 6.65 | 1,436 |
| April 6 | do | 6.65 | 1,448 |
| April 12 | Richins and Earle | 19.0 | 35,550 |
| April 14 | W. Richins | 11.4 | 15,110 |
| April 21 | do | 6 8 | 3,115 |
| April 21 | do | 6.3 | 2,041 |
| April 25 | do | 6.15 | 1,694 |
| April 28 | do | 6.2 | 1,797 |
| May 2 | do | 5.76 | 1,195 |
| May 5 | do | 5.4 | 980 |
| May 10 | do | 5.8 | 1,282 |
| May 12 | do | 5.4 | 989 |
| May 19 | do | 4.70 | 640 |
| May 23 | do | 4.48 | 470 |
| May 25 | do | 4.45 | 428 |
| May 26 | do | 4.4 | 408 |
| May 30 | W. B. Richins | 4.3 | 389 |
| June 1 | do | 4.3 | 389 |
| June 2 | do | 4.25 | 385 |
| June 6 | do | 4.13 | 410 |
| June 8 | do | 4.1 | 358 |
| June 9 | do | 4.15 | 334 |
| June 12 | do | 4.05 | 291 |
| June 13 | W. Richins | 4.03 | 279 |
| June 15 | do | 3.98 | 278 |
| June 17 | do | 3.95 | 299 |
| June 20 | do | 3.91 | 245 |
| June 22 | do | 3.86 | 237 |
| June 24 | do | 3.81 | 237 |
| June 27 | do | 3.75 | 188 |
| June 29 | do | 3.72 | 191 |
| July 1 | do | 3.7 | 205 |
| July 4 | do | 3.61 | 157 |
| July 6 | do | 3.58 | 131 |
| July 8 | do | 3.57 | 132 |
| July 11 | do | 3.56 | 128 |
| July 13 | do | 3.55 | 132 |
| July 15 | do | 4.12 | 323 |
| July 18 | do | 3.80 | 243 |
| July 20 | do | 3.70 | 181 |
| July 22 | do | 3.61 | 158 |
| July 25 | W. Richins | 3.70 | 178 |
| July 27 | do | 3.70 | 180 |
| July 29 | do | 4.83 | 668 |
| August 1 | do | 4.50 | 517 |
| August 3 | do | 4.38 | 436 |
| August 5 | do | 4.10 | 330 |
| August 8 | do | 4.00 | 291 |
| August 10 | do | 4.67 | 540 |
| August 12 | do | 5.00 | 737 |
| August 16 | do | 4.25 | 372 |
| August 22 | do | 4.20 | 333 |
| August 24 | do | 4.95 | 764 |
| August 29 | do | 5.07 | 746 |
| August 31 | do | 4.70 | 491 |
| September 2 | do | 4.73 | 521 |
| September 5 | do | 4.45 | 426 |
| September 7 | do | 6.90 | 2,961 |
| September 9 | do | 5.40 | 1,046 |
| September 12 | do | 4.65 | 426 |
| September 15 | do | 4.38 | 391 |
| September 19 | do | 4.15 | 302 |
| September 21 | do | 4.00 | 280 |
| September 23 | do | 4.00 | 275 |
| September 26 | do | 5.23 | 975 |
| September 30 | do | 8.80 | 5,899 |
| October 4 | do | 4.70 | 675 |
| October 7 | do | 4.35 | 404 |
| October 10 | do | 4.20 | 364 |
| October 12 | do | 4.10 | 361 |
| October 14 | do | 4.08 | 321 |
| October 17 | do | 4.05 | 302 |
| October 19 | do | 4.02 | 316 |
| October 21 | do | 4.0 | 293 |
| October 26 | do | 4.01 | 308 |
| October 28 | do | 4.03 | 319 |
| October 31 | do | 4.01 | 311 |
| November 2 | do | 3.96 | 328 |
| November 4 | do | 3.99 | 301 |
| November 7 | do | 4.20 | 392 |
| November 9 | do | 5.70 | 1,885 |
| November 11 | do | 5.15 | 1,168 |
| November 14 | do | 4.45 | 622 |
| November 16 | do | 4.35 | 466 |
| November 18 | do | 4.3 | 415 |
| November 22 | do | 4.5 | 504 |
| November 24 | do | 5.0 | 1,012 |

*Daily gage height, in feet, of Verde River at McDowell, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.08 | 2.16 | 15.0 | [a]6.9 | 5.85 | 4.25 | 3.7 | 4.45 | 4.98 | [b]7.4 | 4.01 | [a]6.6 |
| 2 | 1.09 | 2.18 | 11.35 | 6.82 | 5.65 | 4.22 | [b]3.6 | 4.39 | [a]4.75 | [b]5.95 | 4.01 | [a]5.9 |
| 3 | 1.08 | 2.74 | 10.45 | 6.75 | 5.55 | 4.2 | 3.63 | 4.31 | [b]4.65 | 4.92 | 4.0 | 5.3 |
| 4 | 1.06 | 13.25 | 10.1 | 6.68 | 5.48 | [b]4.15 | 3.6 | 4.19 | 4.55 | 4.68 | [a]3.99 | 4.95 |
| 5 | 1.05 | 13.25 | 9.75 | 6.6 | 5.4 | 4.13 | 3.57 | [a]4.1 | 4.4 | 4.52 | [b]4.05 | 4.7 |
| 6 | 1.05 | 10.25 | 9.0 | 6.65 | 5.45 | 4.12 | 3.57 | [b]4.08 | 5.53 | 4.42 | 4.12 | 4.45 |
| 7 | [a]1.05 | 8.15 | 8.65 | 6.65 | [a]5.45 | 4.1 | 3.57 | 4.02 | 6.65 | 4.32 | 4.5 | 4.32 |
| 8 | [b]1.15 | 6.4 | 8.4 | 6.62 | 6.0 | 4.1 | 3.56 | 3.98 | 5.62 | [b]4.25 | 5.12 | 4.22 |
| 9 | 1.25 | 5.3 | 7.8 | 6.6 | 6.15 | 4.13 | [b]3.55 | 4.75 | [a]5.4 | 4.22 | 5.62 | [a]4.2 |
| 10 | 6.75 | 4.6 | 7.38 | 6.66 | 5.7 | [a]3.98 | 3.56 | 4.75 | [b]4.65 | 4.18 | 5.45 | [a]4.0 |
| 11 | 7.4 | [a]4.62 | 6.95 | 9.4 | 5.5 | [b]4.0 | 3.55 | 5.08 | 4.75 | 4.12 | [a]5.15 | 4.0 |
| 12 | 6.15 | [a]5.4 | 6.9 | 17.75 | 5.32 | 4.05 | 3.54 | 5.2 | 4.62 | 4.09 | [b]4.8 | 3.92 |
| 13 | 3.8 | [a]4.8 | 9.85 | 15.0 | 6.1 | 4.02 | 3.56 | 4.63 | 4.52 | 4.09 | 4.6 | 3.86 |
| 14 | 3.1 | 3.85 | 15.1 | 11.4 | [a]5.7 | 3.97 | 3.68 | [a]4.5 | 4.42 | [a]4.08 | 4.45 | 3.82 |
| 15 | 2.85 | 3.55 | 11.35 | 10.85 | 5.25 | 3.97 | [a]4.1 | 4.35 | 4.36 | [b]4.07 | 4.38 | 3.76 |
| 16 | 2.65 | 3.5 | 11.45 | 9.7 | 4.95 | 3.97 | [b]3.95 | 4.28 | [a]4.3 | 4.06 | 4.35 | [a]3.75 |
| 17 | 2.55 | 6.1 | 16.25 | 8.5 | 4.85 | 3.95 | 3.88 | 4.25 | [b]4.21 | 4.03 | 4.32 | [b]3.7 |
| 18 | 2.85 | 8.6 | 14.55 | 7.7 | 4.75 | 3.9 | 3.79 | 4.3 | 4.12 | 4.01 | [a]4.3 | 3.68 |
| 19 | 2.72 | 7.95 | [a]12.0 | 7.0 | 4.68 | [b]3.9 | 3.73 | [a]4.15 | 4.12 | 4.02 | [b]4.27 | 3.66 |
| 20 | 2.59 | 6.5 | [b]11.4 | 6.45 | 4.65 | 3.9 | 3.68 | 4.08 | 4.08 | 4.0 | 4.25 | 3.66 |
| 21 | [a]2.5 | 5.85 | [b]10.8 | 6.25 | [a]4.6 | 3.85 | 3.63 | 4.05 | 4.0 | [a]4.0 | 4.35 | 3.73 |
| 22 | [b]2.41 | 5.45 | [b]10.2 | [a]6.1 | 4.52 | 3.85 | [a]3.61 | 4.18 | 4.0 | [b]4.0 | 4.6 | 3.76 |
| 23 | 2.32 | 6.2 | [b]9.6 | [b]6.1 | 4.46 | 3.82 | [b]3.62 | 5.0 | [a]4.0 | 4.0 | 5.0 | 3.82 |
| 24 | 2.28 | 12.0 | [a]9.0 | 6.2 | 4.42 | 3.8 | 3.64 | 4.9 | 4.3 | 4.0 | 4.98 | [b]3.75 |
| 25 | 2.26 | [b]9.1 | 8.75 | 6.5 | [b]4.42 | 3.78 | 3.68 | 5.52 | 4.75 | 4.02 | [a]4.95 | [a]3.68 |
| 26 | 2.29 | [b]8.2 | [a]8.6 | 6.85 | 4.38 | 3.76 | 3.65 | [a]6.1 | 5.02 | 4.0 | [b]5.5 | 3.65 |
| 27 | 2.27 | 8.25 | [b]8.2 | 6.35 | 4.35 | 3.74 | 3.68 | [b]5.7 | 4.8 | 4.0 | 17.0 | 3.64 |
| 28 | 2.27 | 14.0 | [a]7.8 | 6.2 | [a]4.32 | 3.72 | 4.4 | 5.25 | 4.85 | [a]4.03 | [b]10.0 | 3.63 |
| 29 | 2.25 | ....... | 7.6 | [a]6.1 | 4.28 | 3.71 | [a]4.85 | 5.02 | 5.4 | [b]4.0 | [b]8.0 | 3.61 |
| 30 | [b]2.2 | ....... | 7.15 | [b]6.0 | 4.27 | 3.69 | [a]5.5 | 4.85 | 8.45 | 3.99 | [a]7.2 | 3.61 |
| 31 | 2.16 | ....... | 6.95 | ....... | 4.27 | ....... | 4.85 | 4.65 | ....... | 4.01 | ....... | [b]3.61 |

[a] One gage reading.

[b] Estimated.

NOTE.—Gage changes from No. 3 to No. 2 February 24.

*Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 248 | 499 | 25,130 | 1,819 | 1,342 | 370 | 205 | 490 | 720 | 4,080 | 325 | 3,280 |
| 2 | 250 | 507 | 10,580 | 1,710 | 1,145 | 370 | 185 | 452 | 535 | 2,200 | 340 | 2,400 |
| 3 | 248 | 968 | 8,800 | 1,615 | 1,082 | 380 | 173 | 403 | 490 | 920 | 321 | 1,850 |
| 4 | 243 | 32,970 | 8,107 | 1,520 | 1,037 | 380 | 155 | 365 | 455 | 665 | 301 | 1,535 |
| 5 | 241 | 32,970 | 7,414 | 1,411 | 987 | 385 | 137 | 330 | 410 | 515 | 325 | 1,310 |
| 6 | 241 | 19,310 | 5,928 | 1,478 | 1,018 | 400 | 132 | 325 | 1,200 | 440 | 355 | 1,087 |
| 7 | 241 | 9,743 | 5,276 | 1,478 | 1,018 | 380 | 132 | 297 | 2,550 | 390 | 575 | 981 |
| 8 | 263 | 5,400 | 4,884 | 1,439 | 1,507 | 358 | 130 | 285 | 1,270 | 370 | 1,200 | 905 |
| 9 | 285 | 3,750 | 3,946 | 1,411 | 1,696 | 335 | 128 | 630 | 1,046 | 360 | 1,775 | 890 |
| 10 | 8,674 | 2,700 | 3,289 | 1,493 | 1,177 | 277 | 130 | 585 | 475 | 355 | 1,550 | 750 |
| 11 | 10,060 | 2,730 | 2,617 | 6,433 | 1,050 | 283 | 128 | 785 | 535 | 355 | 1,168 | 750 |
| 12 | 7,394 | 3,900 | 2,539 | 32,140 | 949 | 291 | 125 | 860 | 410 | 355 | 865 | 694 |
| 13 | 2,379 | 3,000 | 7,612 | 24,640 | 1,655 | 280 | 130 | 525 | 400 | 340 | 700 | 656 |
| 14 | 1,400 | 1,637 | 25 500 | 15,160 | 1,205 | 270 | 164 | 455 | 385 | 321 | 622 | 632 |

*Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 1,100 | 1,403 | 10,580 | 13,720 | 925 | 275 | 315 | 404 | 380 | 318 | 525 | 596 |
| 16 | 860 | 1,367 | 10,780 | 10,710 | 760 | 290 | 280 | 385 | 360 | 305 | 466 | 590 |
| 17 | 755 | 4,950 | 29,410 | 7,566 | 715 | 300 | 262 | 364 | 325 | 298 | 435 | 560 |
| 18 | 1,100 | 9,767 | 23,460 | 5,471 | 660 | 267 | 240 | 383 | 300 | 300 | 415 | 548 |
| 19 | 944 | 8,641 | 12,120 | 3,639 | 630 | 255 | 207 | 327 | 297 | 316 | 400 | 536 |
| 20 | 791 | 6,130 | 10,630 | 2,337 | 600 | 237 | 175 | 315 | 293 | 298 | 383 | 536 |
| 21 | 710 | 5,004 | 9,368 | 1,893 | 555 | 230 | 165 | 280 | 275 | 293 | 423 | 578 |
| 22 | 642 | 4,311 | 8,110 | 1,617 | 495 | 235 | 158 | 327 | 275 | 296 | 580 | 596 |
| 23 | 583 | 5,010 | 6,855 | 1,617 | 440 | 230 | 160 | 753 | 275 | 300 | 1,000 | 632 |
| 24 | 559 | 12,170 | 5,594 | 1,782 | 422 | 230 | 165 | 735 | 345 | 303 | 1,000 | 590 |
| 25 | 548 | 6,126 | 5,070 | 2,448 | 415 | 217 | 175 | 1,085 | 570 | 306 | 955 | 548 |
| 26 | 564 | 4,572 | 4,755 | 3,246 | 400 | 200 | 165 | 1,617 | 805 | 305 | 1,610 | 530 |
| 27 | 553 | 4,650 | 3,916 | 2,115 | 390 | 183 | 175 | 1,160 | 625 | 305 | [a]61,460 | 524 |
| 28 | 553 | 21,050 | 3,077 | 1,782 | 380 | 187 | 435 | 870 | 650 | 319 | 13,115 | 518 |
| 29 | 542 | ....... | 2,770 | 1,617 | 375 | 190 | 685 | 715 | 1,125 | 305 | 5,520 | 506 |
| 30 | 515 | ....... | 2,158 | 1,507 | 375 | 192 | 1,080 | 590 | 5,350 | 305 | 4,240 | 506 |
| 31 | 499 | ....... | 1,887 | ....... | 375 | ....... | 710 | 465 | ....... | 311 | ........ | 506 |

[a] Calculated from Kutter's formula.

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly discharge of Verde River at McDowell, Ariz., for 1905.*

[Drainage area, 6,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 10,060 | 241 | 1,419 | 87,250 | 0.236 | 0.272 |
| February | 32,970 | 499 | 7,709 | 428,100 | 1.28 | 1.33 |
| March | 29,410 | 1,887 | 8,780 | 539,900 | 1.46 | 1.68 |
| April | 32,140 | 1,411 | 5,227 | 311,000 | .871 | .972 |
| May | 1,696 | 375 | 832 | 51,160 | .139 | .160 |
| June | 400 | 183 | 283 | 16,840 | .047 | .052 |
| July | 1,080 | 125 | 245 | 15,060 | .041 | .047 |
| August | 1,617 | 280 | 567 | 34,860 | .094 | .108 |
| September | 5,350 | 275 | 771 | 45,880 | .128 | .143 |
| October | 4,080 | 293 | 544 | 33,450 | .091 | .105 |
| November | 61,460 | 301 | 3,432 | 204,200 | .572 | .638 |
| December | 3,280 | 506 | 875 | 53,800 | .146 | .168 |
| The year | 61,460 | 125 | 2,557 | 1,822,000 | .426 | 5.68 |

## SANTA CRUZ RIVER AT TUCSON, ARIZ.

This station was established October 15, 1905, by G. E. P. Smith. It is located at Congress Street Bridge, Tucson, Ariz.

The channel is straight for 500 feet above and 300 feet below the station. The current is swift. The left bank is low, wooded, and liable to overflow. The right bank is about 12 feet high and not liable to overflow. The bed of the stream is composed of bowlders, and shifts during floods.

Discharge measurements are made from the bridge, which consists of one steel span 100 feet long and four pile bents each 15 feet long. The initial point for soundings is the east edge of upstream cylindrical pier on the west bank.

The gage is painted on the pier, which is taken as the initial point. During 1905 the gage was read twice each day by George S. Calliahan.

*Discharge measurements of Santa Cruz River at Tucson, Ariz., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| November 27 | G. E. P. Smith | 68 | 46 | 5.40 | 1.58 | 251 |
| November 28 | do | 90 | 317 | 7.90 | 3.60 | 2,515 |
| December 27 | do | 44 | 17 | 2.40 | 0.65 | 40 |

*Daily gage height, in feet, of Santa Cruz River at Tucson, Ariz., for 1905.*

| Day. | Nov. | Dec. |
|---|---|---|
| 1 | | 1.0 |
| 2 | | 1.0 |
| 8 | 1.65 | |
| 9 | 1.25 | |
| 22 | 1.65 | |
| 23 | 1.20 | |
| 24 | 2.0 | |
| 25 | 1.3 | |
| 26 | 1.1 | |
| 27 | 1.38 | |
| 28 | 3.85 | |
| 29 | 2.4 | |
| 30 | 1.45 | |

NOTE.—All water taken out by canals heading above station, leaving the river channel dry at station except on days for which gage heights are recorded.

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# CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 175.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States—folios and separate sheets thereof; (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

Most of the above publications may be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they may be obtained, free of charge (except classes 2, 7, and 8), on application.
2. A certain number are delivered to Senators and Representatives in Congress, for distribution.
3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they may be had at practically cost.
4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they may be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports.

*Series P.*—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888-1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

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Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Texas; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Braly Building; San Francisco Cal., 432 Merchants' Exchange Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Great Falls, Mont.; Hazen, Nev.; Boise, Idaho; Spokane, Wash., 424 Peyton Block; Pendleton, Oreg.

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SEPTEMBER, 1906.

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Water-Supply and Irrigation Paper No. 176 Series P, Hydrographic Progress Reports, 52

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

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# REPORT
OF
# PROGRESS OF STREAM MEASUREMENTS
FOR
# THE CALENDAR YEAR 1905

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PREPARED UNDER THE DIRECTION OF F. H. NEWELL

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## PART XII.—The Great Basin Drainage

BY

**M. C. HINDERLIDER, G. L. SWENDSEN, and HENRY THURTELL**

WASHINGTON
GOVERNMENT PRINTING OFFICE
1906

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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART XII.

By M. C. HINDERLIDER, G. L. SWENDSEN, and HENRY THURTELL.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time appropriations have been gradually increased, as shown by the following table:

*Annual appropriations for hydrographic surveys for the fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention.

In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165 to 178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

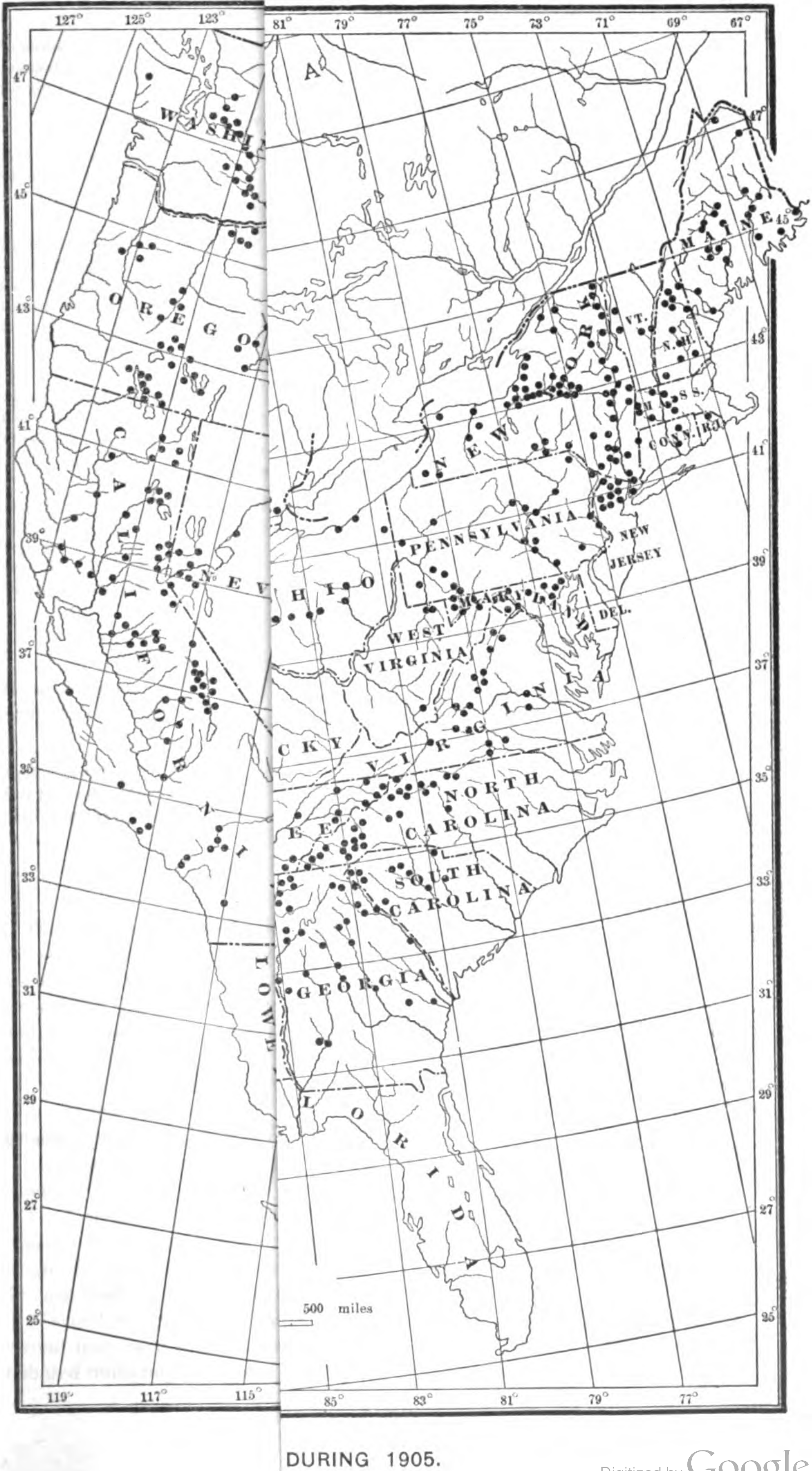
### *Drainage basins in the United States.*

#### NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.

#### SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor Southern Atlantic.


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
47°
45°
43°
41°
39°
37°
35°
33°
31°
29°
27°
25°
WASHI
OREGO
CALIFORNIA
NEV
OHIO
CKY
NEE
LOWE
A
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
NEW YORK
PENNSYLVANIA
NEW JERSEY
DEL.
MARYLAND
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
500 miles
119°
117°
115°
85°
83°
81°
79°
77°

DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadelupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS.

## DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent the rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than that given in this column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two, and not more than four, significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

*Special rules for computation.*

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25, 0.125. 0.012, 0.0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet deep; 13.572 inches deep.

1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot falling 10 feet equals 1.136 horsepower.

100 California miner's inches equal 15 United States gallons per second.

100 California miner's inches equal 77 Colorado miner's inches.

100 California miner's inches for one day equals 4 acre-feet.

100 Colorado miner's inches equal 2.60 second-feet.

100 Colorado miner's inches equal 19.5 United States gallons per second.

100 Colorado miner's inches equal 130 California miner's inches.

100 Colorado miner's inches for one day equal 5.2 acre-feet.

100 United States gallons per minute equal .223 second-foot.

100 United States gallons per minute for one day equal 0.44 acre-foot.

1,000,000 United States gallons per day equal 1.55 second-feet.

1,000,000 United States gallons equal 3.07 acre-feet.

1,000,000 cubic feet equal 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.

1 inch deep on 1 square mile equals 2,323,200 cubic feet.

1 inch deep on 1 square mile equals 0.0737 second-foot per year.

1 inch equals 2.54 centimeters.

1 foot equals 0.3048 meter.

1 yard equals 0.9144 meter.

1 mile equals 1.60935 kilometers.

1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.

1 square yard equals 0.836 square meter.

1 acre equals 0.4047 hectare.

1 acre equals 43,560 square feet; equals 4,840 square yards.

1 acre equals 209 feet square, nearly.

1 square mile equals 259 hectares.

1 square mile equals 2.59 square kilometers.

1 cubic foot equals 0.0283 cubic meter.

1 cubic foot equals 7.48 gallons; equals 0.804 bushel.

1 cubic foot of water weighs 62.5 pounds.

1 cubic yard equals 0.7646 cubic meter.

1 cubic mile equals 147,198,000,000 cubic feet.

1 cubic mile equals 4,667 second-feet for one year.

1 gallon equals 3.7854 liters.

1 gallon equals 8.36 pounds of water.

1 gallon equals 231 cubic inches (liquid measure).

1 pound equals 0.4536 kilogram.

1 avoirdupois pound equals 7,000 grains.

1 troy pound equals 5,760 grams.

1 meter equals 39.37 inches. Log. 1.5951654.

1 meter equals 3.280833 feet. Log. 0.5159842.

1 meter equals 1.093611 yards. Log. 0.0388629.

1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.

1 square meter equals 10.764 square feet; equals 1.196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$=Net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; $l$=length of weir in inches; $h$=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1:125000, 1 mile=0.50688 inch.
Scale 1:90000, 1 mile=0.70400 inch.
Scale 1:62500, 1 mile=1.01376 inches.
Scale 1:45000, 1 mile=1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given.

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{r\,s}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$, which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope, as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions, and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head, on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

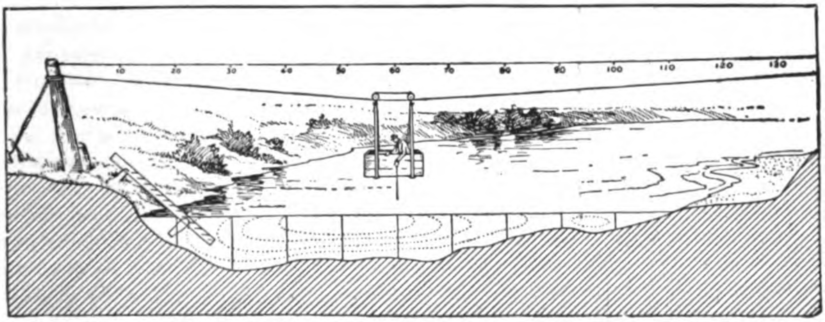


FIG. 1.—Cable station showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared, which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading; and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity curve, 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig, 1. and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pages 141-148.

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

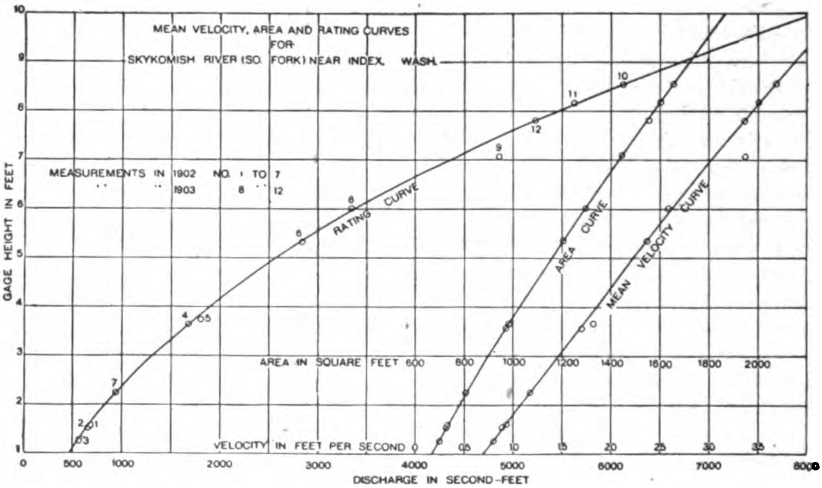


FIG. 2—Rating, area, and mean-velocity curves for South Fork of Skykomish River near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remains constant. (2) The discharge will be the same whenever the stream is at a given stage, if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half-tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of the daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In the case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods, rating tables can be prepared for periods between such changes, and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following list, arranged alphabetically by States, gives the names of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

*California.*—The hydrographic work in Susan and Owens rivers drainages in eastern California was under the direction of J. B. Lippincott, supervising engineer; W. B. Clapp, district hydrographer; assisted by R. J. Taylor, J. S. Evans, F. R. S. Buttemer, and J. Branham. The results of the data collected in Owens River Valley are contained in Water-Supply Paper No. 177, which contains the results of all the hydrographic data collected in the State of California during 1905.

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*Idaho.*—The work in that portion of Idaho which lies in the Great Basin was under the direction of George L. Swendsen, district engineer, assisted by W. G. Swendsen, hydrographer.

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## GENERAL DESCRIPTION OF THE GREAT BASIN.

In the interior of the North American continent, west of the Rocky Mountains, is an immense area known as the Great Basin, the streams of which do not discharge to the ocean. The area is not one single drainage basin, but consists rather of a number of basins, some of which are connected and others closed; the outer rim of all, however, is at such an elevation that the region as a whole has no surface outlet.

In outline the Great Basin is rudely triangular. It is bordered on the west by the Sierra Nevada, on the north by the Columbia plateaus, on the east by the Rocky Mountains and the Colorado plateaus, and the southern extremity extends almost to the Gulf of California. This inclosed area is approximately 800 miles long from north to south, 500 miles broad at its widest part, and has been estimated to include 208,000 square miles. It comprises the western part of Utah, almost all of Nevada, and contiguous parts of Idaho, Oregon, and California.

Topographically this interior drainage area is characterized by isolated, narrow mountain ranges, trending north and south, which are seperated by broad valleys varying considerably in altitude. In the southern part the valleys are low, Death Valley being below sea level, while in the north the valleys have a general elevation of from 4,000 to 5,000 feet. The intervening highlands often rise several thousand feet above their bases, and some of the peaks of the bordering ranges attain elevations of 13,000 feet above sea level.

Upper branches of the intermontane valleys extend into the interior ranges as narrow drainage ways that are dry during most of the year; but the drainage from the high mountains on the east and west borders of the basin passes through deep canyons into the broad valleys, where the perennial streams maintain lakes. Among these are Great Salt, Utah, and Sevier lakes in the eastern part, and Pyramid, Winnemucca, Honey, Walker, Mono, and Owens lakes in the western part of the Great Basin. With the exception of Utah Lake, which discharges by Jordan River into Great Salt Lake, these lakes are saline in character, as a consequence of the concentration of salts due to evaporation. Bear Lake, in the mountains of the eastern border, and Lake Tahoe, in the Sierras, are large bodies of fresh water that drain, respectively, to Great Salt and Pyramid lakes. Shallow, temporary bodies of water accumulate in some of the broad intermontane valleys during the wet season, but completely evaporate during the summer, leaving muddy plains called playas.

Geologically the Great Basin is well known as the type region of the "Basin Range structure." Many of the isolated, narrow mountain ranges that trend north and south are steep on one side, exposing cross sections of the rocks, and sloping on the other, conforming with the dip of the strata. These ranges have been uplifted by movements of the earth's crust which have broken it into tilted blocks. The greatest displacements of the Great Basin are associated with the eastern and western borders, the Wasatch Mountains and the Sierra Nevada having been uplifted many thousand feet. The mountains of the Great Basin are commonly composed of Paleozoic strata, often modified by vulcanism, and the products of weathering and disintegration of these rocks have accumulated in the broad intervening valleys, which are strewn to great depths with unconsolidated débris.

The climate of the Great Basin is extremely arid, and except a few favored spots where irrigation is practiced, the region in general is a desert. Over the larger part of the area the annual precipitation is less than 10 inches, but it is greater on the bordering high lands, especially on the Sierra Nevada, where it is over 40 inches. Temperature varies widely, owing to the large extent of the area and to differences in elevation. Over most of the region the heat of the summer days is intense, but the diurnal variation is considerable. Evaporation is enormous. From the surface of water in the vicinity of Salt Lake City it amounts to about 60 inches in a year, and over the major part of the Great Basin it is much greater, amounting in places possibly to 150 inches.

An arid climate, however, has not always prevailed in this region. In late geologic time (early Quaternary) the bordering high mountains supported glaciers, and enormous lakes, the old shore lines of which are now plainly marked on the sides of many valleys, accumulated in the Great Basin. The two largest of these lakes have been named after early explorers. Lake Bonneville occupied a considerable part of western Utah, its shrunken remnants being represented by Sevier, Utah, and Great Salt lakes; and Lake Lahontan covered an immense area in western Nevada.

The chief rivers of the Great Basin rise in the mountains which form its eastern and western borders and receive their principal supply from melting snow. The nature of the stream discharge is characteristic; the maximum commonly occurs in late spring or early summer, after which the flow decreases, reaching a minimum during the winter months. After leaving the mountains the streams receive little or no increment; in the broad, waste-filled valleys evaporation and seepage cause diminution in size, and often they entirely cease to flow.

For convenience of treatment, the drainage of the Great Basin has been divided into four areas, viz, Wasatch Mountains, Humboldt Sink, Sierra Nevada, and minor Great Basin drainages. The data collected in these areas during 1905 are given in the following pages:

## WASATCH MOUNTAINS DRAINAGE.

### PRINCIPAL STREAMS.

The Wasatch Mountains drainage area includes the western half of Utah and small portions of Idaho and Wyoming. The headwaters of the various streams lie either in the Wasatch Mountains or in the plateaus to the south, and they drain either into Great Salt Lake or Sevier Lake. The following are the principal rivers of the area:

Bear and Weber rivers, discharging into Great Salt Lake.

City, Parleys, Emigration, Mill, and Big and Little Cottonwood creeks, tributary to Jordan River and thus to Great Salt Lake. These creeks have small watersheds, but in the mountain courses maintain perennial flows. On reaching the main valley they are extensively used for irrigation and the first three furnish the chief water supply for Salt Lake City.

American Fork and Hobble creeks, Spanish Fork, and Provo River, discharging into Utah Lake.

Sevier River, with its tributary, San Pitch River, draining into Sevier Lake.

## BEAR RIVER BASIN.

### DESCRIPTION OF BASIN.

Bear River rises on the northern slope of the Uinta Mountains, in the northeastern part of Utah, and after a circuitous course—in which it leaves Utah and enters Wyoming, reenters Utah, appears again in Wyoming, and makes a long detour in Idaho—it returns again to Utah and finally discharges its waters into Great Salt Lake. The maximum elevation of the upper rim of the basin is 13,000 feet.

In the upper part of its course, above the Dingle gaging station, the country is rough and broken, the rocks of the extreme headwater regions being principally sandstone and quartzite, covered with a thin layer of soil which supports scattered groves of fir and aspen. Farther down the prevailing formation is a compact limestone covered with a clayey soil, generally dry and with a rank growth of sagebrush. The tributary streams are numerous and well distributed, but they are generally short and confined to steep, narrow canyons. There are no marshes, extensive meadows, or forests, but a few small lakes lie near the head of the river. Numerous small springs and the melting snow which comprises the greater part of the precipitation are the chief sources of suppply. The annual high-water period occurs during May and June, and the stream is not subject to quick floods or freshets.

Just below Dingle the main stream passes through the north end of Bear Lake Valley in a well-defined channel with no overflow, and from this point to Preston it is confined largely to a steep, narrow canyon, with occasional small, narrow valleys containing irrigated farms. The tributaries in this portion of the basin are few, the principal ones being Mink and Cottonwood creeks. About 10 miles below Dingle the outlet to Bear Lake joins the river. This is a small, crooked, sluggish stream, that discharges but little water at any time, though it is the only visible outlet to Bear Lake, which has an area of about 144 square miles.

The total unappropriated flow between Dingle and Preston is used for irrigation. There is no storage on the main stream, but on Mink Creek a number of small storage reservoirs are contemplated or in process of construction, the water to be diverted for the irrigation of lands in the northwest end of Cache Valley.

Between Preston and Collinston the Bear is a sluggish stream, traversing the west side of Cache Valley in a well-defined channel, which during extreme floods overflows slightly and covers a very narrow strip immediately along the river. The principal tributary streams in this portion of the course are Cub Creek and Logan River. The former has its source in the Bear River Range, and drains a rough country composed of limestone with but little overlying soil. The creek is confined to a steep, narrow canyon until it reaches Cache Valley, where it flows sluggishly for about 15 miles through a winding, but well-defined, channel into Bear River. It discharges considerable water into the main stream during flood and winter seasons, but its entire summer flow is used for irrigation in the north end of Cache Valley. A gaging station was maintained during a part of 1900 and 1901 on Cub Creek about 4 miles northeast of Franklin, at the mouth of the canyon, but, owing to unfavorable conditions, it was discontinued.

Logan River enters the Bear about 7 miles above the gaging station at Collinston, a short distance above the point where it leaves Cache Valley and enters the canyon.

Practically the only inflow to the Bear in Cache Valley is from seepage and springs. The lower portions of the valley form an artesian basin containing numerous small, flowing wells. The water table lies very near the surface, and during the early spring the lower lands are largely swamp.

The Bear River Canal Company diverts the entire summer flow of the stream above Collinston onto agricultural lands lying on both sides of the river below Bear River Canyon. This system has a capacity of about 1,000 second-feet, and during the winter and flood seasons a part of the water is used to develop electric power at a point about one-fourth mile above the Collinston station, being returned to the river at Collinston. From 10 to 30 second-feet reach the stream through leaks and as seepage from the diversion canals.

Owing to the complete control of the stream by irrigation works, the discharge is liable to extreme variation at any period.

### BEAR LAKE AT FISHHAVEN, IDAHO.

This station was established October 5, 1903. It is located at Fishhaven, Idaho, on the west shore of Bear Lake, about 4 miles north of the Idaho-Utah State line. It is on land used as a summer resort, owned by G. C. Gray, of Montpelier, Idaho, and is immediately south of the summer resort known as Nelsons Camp.

A plain staff gage, read when the surface of the lake is calm by John L. Nelson, is driven vertically into the bed of the lake 10 feet east of a crib where water from a spring rises to the surface. The gage is protected by 2 by 4 inch stakes driven on either side. The spring melts the ice before the regular breaking-up season, the consequence being that the shore at this point is comparatively free from ice, while only a few hundred feet away it is piled up in great, grinding masses. The gage is referred to bench marks as follows: (1) A wooden hub driven flush with the ground, 1 foot south of a 15-inch cottonwood tree, 1 foot east of a fence on the east side of the county road, 142 feet north of the gage, and about 18° to the west; elevation above zero of gage, 12.19 feet. (2) A shoulder cut on an above-ground root of a 20-inch cottonwood tree, 2 feet southeast of the southeast corner of the porch of a house on the summer-resort grounds; it bears 81° W., 93 feet south of the gage rod; elevation above zero of gage, 7.13 feet. By readings on the lake surface here and at the north end of the lake, October 5, 1903, the elevation of the zero of gage was found to be 12.26 feet by the datum used on canal surveys, etc., during 1903. This elevation is probably correct to within 0.05 foot. The elevation above sea level is approximately 6,000 feet.

An extreme high-water mark pointed out by the observer, who has lived here thirty-three years, indicates that twenty or thirty years ago the surface of the lake stood at approximately gage height 6.5 feet. A more definite mark shows a gage height of 6 feet as occurring twenty years ago

*Daily gage height, in feet, of Bear Lake at Fishhaven, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | | | | | | | | 2.7 | | | |
| 5 | 2.5 | | | | | | | 3.0 | | | | |
| 6 | | 2.55 | | | | | | | | | | |
| 8 | | | | 2.9 | | | 3.05 | | | 2.4 | | |
| 10 | | | 2.7 | | | 3.15 | | | | | | 1.85 |
| 11 | | | | | | | | | | | 2.05 | |
| 12 | | | | | | | | 2.9 | | | | |
| 14 | | | | | 3.15 | | | | 2.6 | | | |
| 15 | | 2.55 | | | | | | | | | | |
| 16 | 2.5 | | | | | | | | | 2.3 | | |
| 17 | | | 2.7 | 2.95 | | | | | | | | |
| 18 | | | | | | | | | | | | 1.8 |
| 19 | | | | | | | | 2.8 | | | | |
| 20 | | | | | | 3.15 | 3.03 | | | | 2.0 | |
| 22 | | 2.6 | | | | | | | | | | |
| 23 | | | | | 3.2 | | | | | | | |
| 24 | 2.5 | | | | | | | | | | | |
| 25 | | | 2.75 | 2.1 | | | | | | | | |
| 26 | | | | | | | | | 2.5 | 2.2 | | |
| 27 | | | | | | | | | | | | 1.8 |
| 28 | | 2.65 | | | | | | | | | | |
| 29 | | | | | | | 3.03 | | | | | |
| 30 | | | | 3.05 | | 3.1 | | | | | | |
| 31 | 2.5 | | 2.8 | | 3.25 | | | | | | 1.9 | |

**Note.**—Lake frozen over from February 22 to March 17.

## BEAR RIVER AT DINGLE, IDAHO.

This station was established May 9, 1903. It is located in a cut made by the Oregon Short Line Railroad Company one-fourth mile east of the Dingle railroad station and about 250 feet south of the track.

The channel is straight for about 400 feet above and below the station. Both banks are high, are not liable to overflow, and are barren except for small brush. The bed of the stream is of well-compacted small gravel and soil and seems to be permanent. The velocity is moderate at ordinary stages, and is well distributed. The stream freezes over late in November or early in December, and ordinarily the ice does not begin to break up until late in February. There is no anchor or needle ice at any stage. Winter records at this station are of special importance, as the object of the station is the collection of facts concerning the amount of water available for storage in Bear Lake.

Discharge measurements are made by means of a cable and car of the regular form, the length of the span being 151 feet. The cable is marked at 10-foot intervals with white paint. The initial point for soundings is the first mark from the north and is 8 feet from the north cable support.

The gage, which is read daily by M. K. Hopkins, was originally of the vertical type, but in December, 1905, it was replaced by a new inclined gage, consisting of a 6 by 6 inch fir, fastened to three vertical double posts well embedded in the bank. It is located 3 feet below the old gage and about 25 feet above the cable. The datum of the new gage was made to agree with that of the old one. The gage is referred to bench marks as follows: (1) A United States Geological Survey standard metallic post bearing N. 33° 15′ E., 37 feet from as north end of cable; elevation above zero of gage, 15.59 feet; elevation above mean sea level, determined from Oregon Short Line Railroad elevations, 6,000 feet. (2) Top of south cable post; elevation, 18.04 feet above zero of gage. (3) Top of 4-foot stick of timber planted 2.7 feet in the ground; elevation above zero of gage, 18.42 feet. During the winter of 1904–5 gage readings were taken once or twice each week, the surface of the water being read after the ice had been cut around the gage and the thickness of the ice in each case noted.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 135; 133, p 238.
Discharge: 100, p 135; 138, p 238.
Discharge, monthly: 100, p 137; 133, p 240.
Gage heights: 100, p 136; 133. p 239.
Rating table: 100, p 136; 133, p 240.

*Discharge measurements of Bear River at Dingle, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 13[a] | C. Tanner | 92 | 136 | 1.43 | [b] 4.45 | 194 |
| March 24 | W. G. Swendsen | 107 | 210 | 1.80 | 4.22 | 379 |
| September 19 | .....do | 97 | 136 | .98 | 3.48 | 133 |

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[a] Stream frozen; ice 1 foot thick near the center and increasing gradually to 1.5 feet at either side. No anchor or slush ice.

[b] Surface of water in hole cut in ice.

*Daily gage height, in feet, of Bear River at Dingle, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.8 | ....... | ....... | 4.2 | 4.2 | 3.7 | 3.85 | 3.35 | 3.3 | 3.5 | 3.55 | 3.5 |
| 2 | 4.7 | ....... | 4.8 | 4.1 | 4.15 | 3.95 | 3.8 | 3.4 | 3.3 | 3.5 | 3.55 | 3.5 |
| 3 | 4.6 | 4.8 | ....... | 4.1 | 4.2 | 4.0 | 3.75 | 3.35 | 3.3 | 3.5 | 3.55 | 3.5 |
| 4 | 4.6 | 4.8 | 4.7 | 4.1 | 4.2 | 3.95 | 3.75 | 3.4 | 3.3 | 3.5 | 3.6 | 3.55 |
| 5 | 4.4 | 4.8 | ....... | 4.1 | 4.2 | 4.05 | 3.8 | 3.4 | 3.3 | 3.5 | 3.55 | 3.5 |
| 6 | 4.4 | ....... | 4.45 | 4.05 | 4.15 | 4.2 | 3.8 | 3.35 | 3.4 | 3.5 | 3.55 | 3.5 |
| 7 | 4.5 | ....... | 4.45 | 4.0 | 4.1 | 4.25 | 3.65 | 3.3 | 3.4 | 3.5 | 3.55 | 4.4 |
| 8 | 4.5 | ....... | ....... | 4.0 | 4.1 | 4.5 | 3.5 | 3.3 | 3.4 | 3.5 | 3.5 | 4.4 |
| 9 | 4.5 | ....... | 4.4 | 4.1 | 4.1 | 4.65 | 3.4 | 3.3 | 3.4 | 3.5 | 3.55 | 4.5 |
| 10 | 4.5 | ....... | ....... | 4.1 | 4.1 | 4.6 | 3.45 | 3.3 | 3.4 | 3.5 | 3.55 | 4.25 |
| 11 | 4.6 | 4.6 | 4.4 | 4.1 | 4.05 | 4.6 | 3.5 | 3.3 | 3.4 | 3.5 | 3.55 | ...... |
| 12 | 4.6 | ....... | 4.4 | 4.1 | 4.05 | 4.7 | 3.5 | 3.3 | 3.35 | ....... | 3.55 | ...... |
| 13 | ....... | 4.45 | 4.7 | 4.1 | 4.0 | 4.9 | 3.65 | 3.3 | 3.35 | 3.5 | 3.5 | ...... |
| 14 | 4.6 | 4.45 | 4.4 | 4.1 | 4.0 | 5.0 | 3.7 | 3.3 | 3.35 | 3.5 | 3.55 | 4.35 |
| 15 | ....... | ....... | 4.4 | 4.15 | 4.0 | 4.8 | 3.7 | 3.3 | 3.35 | 3.5 | 3.55 | ...... |
| 16 | ....... | ....... | 4.45 | 4.2 | 3.9 | 4.7 | 3.7 | 3.3 | 3.35 | 3.5 | 3.55 | ...... |
| 17 | 4.7 | ....... | 4.45 | 4.2 | 3.9 | 4.75 | 3.65 | 3.3 | 3.35 | 3.5 | 3.5 | 4.6 |
| 18 | ....... | 4.45 | 4.4 | 4.2 | 4.0 | 4.9 | 3.6 | 3.3 | 3.35 | 3.5 | ....... | ...... |
| 19 | ....... | ....... | 4.4 | 4.2 | 3.9 | 5.05 | 3.6 | 3.3 | 3.45 | 3.5 | 3.55 | ...... |
| 20 | ....... | ....... | 4.4 | 4.2 | 3.9 | 4.95 | 3.6 | 3.2 | 3.5 | 3.5 | 3.55 | ...... |
| 21 | 4.7 | ....... | 4.4 | 4.2 | 3.9 | 4.8 | 3.6 | 3.2 | 3.5 | 3.5 | 3.5 | 4.9 |
| 22 | ....... | 4.7 | 4.3 | 4.2 | 3.9 | 4.65 | 3.55 | 3.2 | 3.5 | 3.5 | 3.55 | ...... |
| 23 | ....... | ....... | 4.3 | ....... | 3.95 | 4.35 | 3.5 | 3.2 | 3.5 | 3.5 | 3.55 | ...... |
| 24 | 4.8 | ....... | 4.2 | 4.2 | 3.95 | 4.2 | 3.5 | 3.2 | 3.5 | 3.5 | 3.55 | ...... |
| 25 | ....... | 4.7 | ....... | 4.2 | 3.95 | 4.1 | 3.5 | 3.2 | 3.5 | 3.55 | 3.55 | 3.8 |
| 26 | ....... | ....... | 4.2 | 4.2 | 3.9 | 4.0 | 3.4 | 3.2 | 3.45 | 3.55 | 3.55 | ...... |
| 27 | ....... | 4.8 | 4.2 | 4.2 | 3.9 | 3.95 | 3.4 | 3.2 | 3.5 | 3.55 | ....... | ...... |
| 28 | 4.7 | ....... | 4.2 | 4.2 | 3.8 | 4.0 | 3.35 | 3.3 | 3.45 | 3.55 | 3.5 | 3.8 |
| 29 | ....... | ....... | 4.2 | 4.2 | 3.8 | 3.95 | 3.3 | 3.3 | 3.5 | 3.6 | 3.3 | ...... |
| 30 | 4.8 | ....... | 4.2 | 4.1 | 3.8 | 3.9 | 3.4 | 3.3 | 3.5 | 3.55 | 3.2 | ...... |
| 31 | ....... | ....... | 4.2 | ....... | 3.75 | ....... | 3.35 | 3.3 | ....... | 3.55 | ....... | 4.0 |

NOTE.—River frozen January 1 to about March 14 and December 7 to 31. During this period the readings were to the water surface in a hole cut in the ice.

The following thicknesses of ice were recorded:

| | Thickness in feet. | | Thickness in feet. |
|---|---|---|---|
| January 4 | 0.75 | February 11 | 1.1 |
| January 8 | 1.0 | February 18 | 1.2 |
| January 21 | 1.2 | February 22 | 1.2 |
| January 24 | 1.2 | February 25 | 1.3 |
| January 28 | 1.2 | February 27 | 1.3 |
| February 4 | 1.1 | March 2 | 1.2 |
| February 5 | 1.1 | March 6 | .7 |

March 11, ice nearly gone. March 18, no ice at gage.

*Station rating table for Bear River at Dingle, Idaho, from March 11 to December 6, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 60 | 3.90 | 260 | 4.70 | 590 | 5.50 | 1,020 |
| 3.20 | 75 | 4.00 | 295 | 4.80 | 635 | 5.60 | 1,085 |
| 3.30 | 90 | 4.10 | 330 | 4.90 | 685 | 5.70 | 1,155 |
| 3.40 | 110 | 4.20 | 370 | 5.00 | 740 | 5.80 | 1,230 |
| 3.50 | 135 | 4.30 | 410 | 5.10 | 790 | 5.90 | 1,300 |
| 3.60 | 160 | 4.40 | 455 | 5.20 | 840 | 6.00 | 1,375 |
| 3.70 | 190 | 4.50 | 495 | 5.30 | 895 | 6.10 | 1,460 |
| 3.80 | 225 | 4.60 | 540 | 5.40 | 955 | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1903–1905. It is well defined between gage heights 3.5 feet and 7.4 feet. Above gage height 6.1 feet the rating curve is a tangent, the difference being 90 per tenth.
The above table is the same as that used for 1904.

*Estimated monthly discharge of Bear River at Dingle, Idaho, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 310 | 180 | 259 | 15,920 |
| February | 310 | 195 | 259 | 14,380 |
| March | 590 | 180 | 365 | 22,440 |
| April | 370 | 295 | 348 | 20,710 |
| May | 370 | 208 | 294 | 18,080 |
| June | 765 | 190 | 467 | 27,790 |
| July | 242 | 90 | 157 | 9,654 |
| August | 110 | 75 | 89 | 5,472 |
| September | 135 | 90 | 113 | 6,724 |
| October | 160 | 135 | 138 | 8,485 |
| November | 160 | 75 | 141 | 8,390 |
| December 1-6 | 147 | 135 | 137 | 1,630 |
| The period | | | | 159,700 |

NOTE.—Discharge interpolated for days when the gage was not read.
Estimates for January, February, and March corrected for effect of ice. They are merely approximate.

## BEAR RIVER NEAR PRESTON, IDAHO.

This station was established October 11, 1889. It is located about 6 miles from Preston, Idaho, 10 miles north of the Idaho-Utah boundary line and about 300 feet below the county road crossing at the old bridge of the Oregon Short Line Railroad. The data collected at this station are of extreme importance as showing the amount of water that passes from Idaho into Utah and will be of great value in the final adjudication of water rights on the stream.

The channel is straight for about 250 feet above and below the station. Both banks are barren and are sufficiently high to prevent overflow. The bed of the stream is of gravel and clay and is permanent. A light growth of moss near the north side of the gaging section interferes slightly with summer records; otherwise the conditions are good. The stream is ice covered from about the end of December to the middle of February. There is no needle ice and but little fluctuation.

Discharge measurements are made by means of a cable and car, rebuilt in 1904. The cable has a span of about 250 feet and is marked at 10-foot intervals with red paint. The initial point for soundings is the north post supporting the cable.

The gage, which is read daily by Mrs. Hannah Nelson, was originally of the vertical type and consisted of a board nailed to a pile of the highway bridge. This was replaced August 4, 1899, by a wire gage, which proved unsatisfactory, and October 31, 1903, a new temporary gage was again attached to the bridge pile. In December, 1904, a new inclined gage was established at a point about 50 feet below the bridge. It consists of a piece of 8 by 8 inch fir, supported by three vertical double posts. The bench mark is a United States Geological Survey standard metallic post, set flush with the surface of the ground at a point about 8 feet upstream from the south post supporting the cable; elevation above zero of gage, 7.428 feet. All readings have been reduced as nearly as possible to the same datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, pp 118–119; 18, iv, p 313; Bull 131, p 53; 140, pp 225; WS 16, p 157; 28, p 146; 38, pp 332–333; 51, p 409; 66, p 117; 85, p 82; 100, pp 133–134; 133, p 241.

Discharge: Ann 18, iv, p 314; Bull 131, pp 53, 92; 140, p 226; WS 16, p 157; 28, p 153; 35, pp 18–19; 38, p 333; 51, p 409; 66, p 117; 85, p 83; 100, p 134; 133, p 241.

Discharge, monthly: Ann 11, ii, p 102; 12, ii, pp 352, 360; 13, iii, p 96; 14, i, p 119; 18, iv, p 315; 19, iv, p 432; 20, iv, p 459; 21, iv, p 394; 22, iv, p 407; Bull 140, p 227; WS 75, p 191; 85, p 84; 133, p 243.

Discharge, yearly: Ann 11, ii, p 69; 13, p 99; 20, iv, p 60.

Gage heights: Bull 131, pp 54–55; 140, p 226; WS 11, p 76; 16, p 157; 28, p 149; 38, p 334; 51, p 410; 66, p 117; 85, p 83; 100, p 134; 133, p 242.

Hydrographs: Ann 12, ii, p 330; 14, ii, p 118; 18, iv, p 316; 19, iv, p 433; 20, iv, p 460; 22, iv, p 407; 75 p 191.

Rating tables: Ann 18, iv, p 314; 19, iv, p 432; Bull 131, p 54; 140, p 226; WS 28, p 154; 39, p 452; 52, p 521; 66, p 176; 85, p 84; 133, p 242.

*Discharge measurements of Bear River near Preston, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 25 | W. G. Swendsen | 188 | 348 | 1.78 | 1.60 | 617 |
| February 17[a] | C. Tanner | 197 | 524 | 1.46 | 2.80 | 766 |
| March 23 | W. G. Swendsen | 192 | 470 | 2.26 | 2.15 | 1,059 |
| March 23 | do | 192 | 470 | 2.27 | 2.15 | 1,067 |
| May 3 | do | 196 | 513 | 2.64 | 2.45 | 1,354 |
| June 7 | do | 187 | 358 | 1.60 | 1.45 | 574 |
| July 11 | do | 152 | 203 | .89 | .60 | 182 |
| August 23 | W. D. Beers | 145 | 216 | .82 | .60 | 177 |
| September 16 | W. G. Swendsen | 171 | 239 | 1.22 | .80 | 291 |
| October 30 | do | 186 | 340 | 1.56 | 1.43 | 528 |

[a] Back water caused by a large quantity of floating ice piled up near the gaging station. This rendered the velocity zero for 60 feet in the middle of the stream. There was a small amount of ice on the edges of the stream at the gaging station, but none near the gage.

*Daily gage height, in feet, of Bear River near Preston, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | 1.5 | 1.5 | 1.88 | 2.15 | 1.7 | ....... | 0.5 | 0.7 | 1.0 | 1.04 | 1.3 |
| 2 | 2.6 | 1.5 | 1.52 | 1.8 | 2.33 | 1.7 | ....... | .5 | .7 | 1.0 | 1.04 | 1.25 |
| 3 | 2.6 | 1.6 | 1.55 | 1.8 | 2.42 | 1.62 | ....... | .5 | .7 | 1.07 | 1.04 | 1.25 |
| 4 | 2.6 | 1.6 | 1.6 | 1.8 | 2.38 | 1.6 | ....... | .5 | .7 | 1.18 | 1.04 | 1.25 |
| 5 | 2.5 | ....... | 1.6 | 1.8 | 2.3 | 1.63 | 0.6 | .62 | .7 | 1.32 | 1.04 | 1.25 |
| 6 | 2.5 | 1.6 | 1.68 | 1.8 | 2.23 | 1.53 | .62 | .5 | .7 | 1.3 | 1.04 | 1.2 |
| 7 | 2.45 | 1.6 | 1.68 | 1.8 | 2.1 | 1.43 | .7 | .5 | .72 | 1.3 | 1.04 | 1.37 |
| 8 | 2.4 | 1.6 | 1.72 | 1.8 | 2.1 | 1.47 | .68 | .5 | .7 | 1.3 | 1.04 | 1.3 |
| 9 | 2.4 | 1.6 | 1.78 | 1.8 | 2.1 | 1.4 | .63 | .5 | .7 | 1.3 | 1.04 | 1.4 |
| 10 | 2.4 | 1.8 | 1.78 | 1.8 | 2.1 | 1.43 | .6 | .5 | .7 | 1.3 | 1.04 | 1.4 |
| 11 | 2.4 | 1.9 | 1.85 | 1.8 | 2.05 | 1.53 | .6 | .5 | .7 | 1.3 | 1.04 | 1.5 |
| 12 | 2.4 | ....... | 1.92 | 1.8 | 2.05 | 1.65 | .6 | .5 | .72 | 1.3 | 1.04 | 1.7 |
| 13 | 2.4 | ....... | 2.0 | 1.8 | 2.0 | 1.67 | .6 | .5 | .8 | 1.35 | 1.04 | 2.0 |
| 14 | 2.4 | ....... | 2.07 | 1.87 | 1.95 | 1.85 | .6 | .5 | .8 | 1.32 | 1.04 | 2.6 |
| 15 | ....... | 2.8 | 2.15 | 1.9 | 1.95 | 1.68 | .6 | .5 | .8 | 1.22 | 1.04 | ...... |
| 16 | 3.5 | 2.72 | 2.2 | 1.9 | 2.0 | 1.6 | .6 | .5 | .8 | 1.05 | 1.04 | ...... |
| 17 | 3.5 | 2.7 | 2.15 | 1.97 | 2.05 | 1.72 | .6 | .5 | .8 | 1.05 | 1.35 | ...... |
| 18 | 3.5 | 2.55 | 2.25 | 2.02 | 2.15 | 1.87 | .6 | .5 | .77 | 1.04 | 1.3 | 2.65 |
| 19 | 1.5 | 2.57 | 2.3 | 2.08 | 2.15 | 1.9 | .6 | .5 | .7 | 1.04 | 1.3 | ...... |
| 20 | 1.5 | 2.48 | 2.27 | 2.0 | 2.15 | 1.9 | .6 | .5 | .8 | 1.04 | 1.35 | ...... |
| 21 | 1.5 | 1.5 | 2.23 | 1.95 | 2.1 | 1.65 | .8 | .5 | .8 | 1.04 | 1.32 | ...... |
| 22 | 1.5 | 1.5 | 2.2 | 1.97 | 2.07 | 1.5 | .8 | .6 | .8 | 1.04 | 1.3 | ...... |
| 23 | 1.6 | 1.5 | 2.12 | 2.0 | 2.0 | 1.42 | .8 | .75 | .8 | 1.04 | 1.3 | 2.45 |
| 24 | 1.6 | 1.5 | 2.1 | 2.0 | 1.95 | 1.32 | .8 | .63 | .8 | 1.04 | 1.27 | ...... |
| 25 | ....... | 1.58 | 2.05 | 2.07 | 1.9 | 1.25 | .75 | .7 | 1.0 | 1.04 | 1.25 | ...... |
| 26 | 1.55 | 1.6 | 2.07 | 2.1 | 1.9 | 1.2 | .7 | .67 | .95 | 1.45 | 1.25 | ...... |
| 27 | 1.5 | 1.55 | 2.1 | 2.05 | 1.9 | 1.0 | .65 | .65 | .9 | 1.45 | 1.25 | ...... |
| 28 | 1.5 | 1.52 | 2.0 | 2.05 | 1.9 | ....... | .6 | .7 | 1.0 | 1.45 | 1.25 | ...... |
| 29 | 1.5 | ....... | 2.0 | 2.05 | 1.87 | ....... | .6 | .7 | 1.0 | 1.45 | 1.27 | ...... |
| 30 | 1.5 | ....... | 2.0 | 2.05 | 1.8 | ....... | .55 | .7 | 1.0 | 1.41 | 1.3 | ...... |
| 31 | 1.5 | ....... | 1.95 | ....... | 1.72 | ....... | .52 | .7 | ....... | 1.41 | ....... | ...... |

NOTE.—River frozen January 1-18 and February 10-20. Ice conditions December 7-31.

*Station rating table for Bear River near Preston, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge | Gage height. | Discharge. | Gage height | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 158 | 1.10 | 371 | 1.60 | 642 | 2.10 | 1,020 |
| .60 | 186 | 1.20 | 418 | 1.70 | 708 | 2.20 | 1,110 |
| .70 | 217 | 1.30 | 468 | 1.80 | 779 | 2.30 | 1,205 |
| .80 | 251 | 1.40 | 522 | 1.90 | 855 | 2.40 | 1,300 |
| .90 | 288 | 1.50 | 580 | 2.00 | 935 | 2.50 | 1,400 |
| 1.00 | 328 |  |  |  |  |  |  |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904-5. It is well defined throughout.

*Estimated monthly discharge of Bear River near Preston, Idaho, for 1905.*

[Drainage area, 4,500 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 19-31 | 642 | 580 | 595 | 15,340 | 0.132 | 0.064 |
| February 1-9; 21-28 | 642 | 580 | 615 | 20,740 | .137 | .087 |
| March | 1,205 | 580 | 907 | 55,770 | .202 | .233 |
| April | 1,020 | 779 | 871 | 51,830 | .194 | .216 |
| May | 1,320 | 722 | 991 | 60,930 | .220 | .254 |
| June | 855 | 328 | 599 | 35,640 | .133 | .148 |
| July | 251 | 164 | 201 | 12,360 | .045 | .052 |
| August | 234 | 158 | 176 | 10,820 | .039 | .045 |
| September | 328 | 217 | 250 | 14,880 | .056 | .062 |
| October | 551 | 328 | 429 | 26,380 | .095 | .110 |
| November | 495 | 346 | 401 | 23,860 | .089 | .099 |
| December 1-6 | 468 | 418 | 443 | 5,272 | .098 | .022 |
| The period | | | | 333,800 | | |

NOTE.—Discharge interpolated on days when gage was not read.

## BEAR RIVER NEAR COLLINSTON, UTAH.

This station was established July 1, 1889. It is located 6 miles from Collinston station on the Oregon Short Line Railroad, about one-fourth mile below the electric-power plant in Bear River Canyon. It is at the lower end of the canyon separating Cache and Great Salt Lake valleys, at a point below all diversion from the stream. It shows the amount of unappropriated water that is discharged as waste into Great Salt Lake.

The stream at this point is wide and shallow. Both banks are sufficiently high to prevent overflow; the west bank slopes gradually, while the east is abrupt. The bed is composed of bowlders and clay and is somewhat rough, but apparently permanent. A deposit of material which was washed into the stream by the water from a spillway at the power plant during 1903 changed the original condition considerably during 1903 and 1904. The cross section was rechecked, however, in March, 1905, and found to agree very closely with the original standard cross section, the new material having been washed out. The velocity ranges from 2 to 4 feet per second. There is a free flow except at a small hole near the east bank. The discharge ranges from 7,000 feet during flood season to nothing during the summer, when the entire flow is diverted for irrigation above the station. The stream probably never freezes entirely over, but ice forms along the edges to quite an extent during December and January.

Discharge measurements were originally made from a small boat attached by means of a chain and pulley to a cable stretched across the stream. During 1904 discharge measurements were made from a bridge recently built across the stream at the power house, but owing to poor conditions at this point a cable and car were established at the old section in January, 1905. The total length of the span is 301 feet. The cable is marked at 20-foot intervals with paint, beginning at the west post, which is the initial point for soundings.

The gage, which is read daily by D. A. Cannon, a watchman along the Bear River canals, consisted originally of a vertical iron bar driven into the river bed and supported at the top by a horizontal bar fastened to posts on the bank. It was replaced in February, 1905, by an inclined gage. This is a 6 by 6 inch fir, fastened by means of iron straps to three posts firmly embedded in the bank, and graduated to read vertically. It is located at the same point as the old vertical gage. The low-water gage is an iron peg driven into the bed of the stream about 50 feet from the west bank. It has the same datum as the regular gage.

The gage is referred to bench marks as follows: (1) A metallic post, 3 inches in diameter and 4 feet long, set in the ground at a point 30 feet S. 74° W. from the west post supporting the cable; elevation, 9.59 feet above zero of gage, and so stamped on the top; (2) a nail in an oak post 20 feet west of the gage and 20 feet north of the cable; elevation above gage datum, 7.35 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water Supply Paper):

Description: Ann 18, iv, p 319; Bull 131, pp 55–56; 140, p 227; WS 16, p 159; 28, p 146; 38, pp 335–336; 51, p 413; 66, p 120, 85, p 80; 100, p 131; 133, p 433.

Discharge: Ann 18, iv, p 319; Bull 131, pp 90, 92; 140, p 228; WS 16, p 159; 28, p 153; 35, pp 18–19; 38, p 336; 51, p 413; 66, p 120; 85, p 80; 100, p 131; 133, p 244.

Discharge, monthly: Ann 11, ii, p 103; 12, ii, pp 352, 360; 13, iii, p 96; 14, ii, pp 120–121; 18, iv, p 320; 19, iv, p 435; 20, iv, pp 458–460; 21, iv, p 395; 22, iv, p 410; Bull 140, p 229; WS 75, p 193; 85, p 82; 100, p 133; 133, p 245.

Discharge, yearly: Ann 11, ii, p 69; 13, iii, p 99; 20, iv, p 60.

Gage heights: Bull 131, pp 56–57; 140, p 229; WS 11, p 77; 16, p 159; 28, p 150; 38, p 336; 51, p 414; 66, p 121; 85, p 81; 100, p 132; 133, p 244.

Hydrographs: Ann 12, ii, p 332; 14, ii, p 121; 18, iv, p 320; 19, iv, p 435; 20, iv, p 461; 21, iv, p 395; 22 iv, p 411.

Rainfall and run-off relation: Ann 20, iv, p 459.

Rating tables: Ann 18, iv, p 320; 19, iv, p 434; Bull 140, p 228; WS 28, p 154; 39, p 453; 52, p 521; 66, p 176; 85, p 81; 100, p 132; 133, p 245.

*Discharge measurements of Bear River near Collinston, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| February 10 | C. Tanner | 270 | 486 | 2.46 | 1.75 | 1,195 |
| March 29 | W. G. Swendsen | 275 | 711 | 2.73 | 2.50 | 1,943 |
| March 29 | do | 275 | 711 | 2.78 | 2.50 | 1,976 |
| May 17 | do | 275 | 684 | 2.79 | 2.45 | 1,910 |
| September 7[a] | A. B. Larson | 19 | 19 | 1.64 | .37 | 31 |
| October 31 | W. G. Swendsen | 268 | 466 | 2.32 | 1.60 | 1,039 |

[a] 350 feet below regular station.

*Daily gage height, in feet, of Bear River near Collinston, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 1.9 | 1.95 | 2.35 | 2.6 | 2.25 | −0.1 | −0.5 | −0.5 | 1.2 | 1.55 | 1.4 |
| 2 | 1.8 | 1.95 | 1.95 | 2.3 | 2.8 | 2.2 | − .1 | − .5 | − .5 | 1.2 | 1.55 | 1.45 |
| 3 | 1.75 | 2.0 | 2.0 | 2.2 | 3.1 | 2.1 | − .15 | − .5 | − .5 | 1.1 | 1.55 | 1.45 |
| 4 | 1.75 | 2.0 | 2.0 | 2.15 | 3.15 | 2.1 | ...... | − .55 | − .5 | 1.1 | 1.55 | 1.45 |
| 5 | 1.8 | 2.0 | 2.0 | 2.1 | 3.0 | 2.05 | − .2 | − .55 | − .5 | 1.1 | 1.55 | 1.5 |
| 6 | 1.9 | 2.0 | 1.95 | 2.1 | 2.9 | 1.95 | − .2 | − .55 | − .5 | 1.1 | 1.55 | 1.45 |
| 7 | 1.8 | 1.9 | 1.9 | 2.1 | 2.75 | 1.8 | − .25 | − .55 | ...... | 1.1 | 1.6 | 1.4 |
| 8 | 1.6 | 1.85 | 1.95 | 2.15 | 2.65 | 1.6 | − .25 | − .55 | − .4 | 1.15 | 1.6 | 1.3 |
| 9 | 1.75 | 1.8 | 1.95 | 2.2 | 2.6 | 1.4 | − .3 | − .55 | − .4 | 1.15 | 1.6 | 1.2 |
| 10 | 1.9 | 1.75 | 1.9 | 2.2 | 2.6 | 1.35 | − .3 | − .55 | − .4 | 1.2 | 1.6 | 1.1 |
| 11 | 1.7 | 1.7 | 1.9 | 2.3 | 2.6 | 1.3 | − .4 | − .55 | − .4 | 1.2 | 1.6 | 1.0 |
| 12 | 1.7 | 1.5 | 1.95 | 2.3 | 2.6 | 1.3 | − .4 | − .55 | − .35 | 1.2 | 1.6 | 1.0 |
| 13 | 1.8 | 1.3 | 2.0 | 2.25 | 2.6 | 1.35 | − .45 | − .5 | − .3 | 1.2 | 1.6 | 1.05 |
| 14 | 1.6 | 1.4 | 2.1 | 2.2 | 2.5 | 1.4 | − .45 | − .5 | − .3 | 1.25 | 1.55 | 1.05 |
| 15 | 1.6 | 1.6 | 2.1 | 2.3 | 2.4 | 1.4 | − .45 | − .5 | + .3 | 1.3 | 1.55 | 1.1 |
| 16 | 1.65 | 1.7 | 2.1 | 2.3 | 2.4 | 1.35 | − .5 | − .5 | .3 | 1.3 | 1.55 | 1.1 |
| 17 | 1.7 | 1.7 | 2.1 | 2.3 | 2.4 | 1.3 | − .5 | − .5 | .3 | 1.3 | 1.55 | 1.15 |
| 18 | 1.75 | 1.7 | 2.15 | 2.3 | 2.5 | 1.4 | − .5 | − .55 | .3 | 1.35 | 1.55 | 1.15 |
| 19 | 1.75 | 1.7 | 2.25 | 2.4 | 2.8 | 1.4 | − .5 | − .55 | .4 | 1.4 | 1.5 | 1.2 |
| 20 | 1.75 | 1.65 | 2.5 | 2.6 | 2.95 | 1.45 | − .5 | − .55 | .4 | 1.45 | 1.5 | 1.25 |
| 21 | 1.7 | 1.65 | 2.4 | 2.6 | 3.0 | 1.45 | − .5 | − .55 | .4 | 1.45 | 1.5 | 1.25 |
| 22 | 1.75 | 1.7 | 2.35 | 2.55 | 3.0 | 1.4 | − .5 | − .55 | .4 | 1.4 | 1.45 | 1.2 |
| 23 | 1.8 | 1.7 | 2.35 | 2.55 | 2.9 | 1.35 | − .45 | − .55 | .4 | 1.45 | 1.45 | 1.2 |
| 24 | 1.8 | 1.8 | 2.4 | 2.5 | 2.85 | 1.1 | − .45 | − .5 | .35 | 1.5 | 1.45 | 1.25 |
| 25 | 1.85 | 1.9 | 2.4 | 2.45 | 2.8 | .6 | − .45 | − .5 | .3 | 1.5 | 1.45 | ...... |
| 26 | 1.85 | 1.9 | 2.4 | 2.5 | ...... | .6 | − .45 | − .45 | .3 | 1.5 | 1.45 | 1.3 |
| 27 | 1.85 | 1.9 | 2.5 | 2.55 | ...... | .55 | − .45 | − .45 | .35 | 1.5 | 1.45 | 1.35 |
| 28 | 1.85 | 1.95 | 2.5 | 2.6 | 2.5 | .55 | − .5 | − .5 | .7 | 1.5 | 1.45 | 1.4 |
| 29 | 1.9 | ...... | 2.5 | 2.6 | 2.55 | .55 | − .5 | − .5 | .65 | 1.5 | 1.5 | 1.45 |
| 30 | 1.95 | ...... | 2.4 | 2.6 | 2.55 | .5 | − .5 | − .5 | .7 | 1.5 | 1.5 | 1.4 |
| 31 | 2.0 | ...... | 2.4 | ...... | 2.4 | ...... | − .5 | − .5 | ...... | 1.6 | ...... | 1.35 |

*Station rating table for Bear River near Collinston, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second feet.* | *Feet.* | *Second feet.* | *Feet.* | *Second feet.* | *Feet.* | *Second feet.* |
| −0.55 | 10 | 0.40 | 266 | 1.40 | 868 | 2.40 | 1,850 |
| −0.50 | 15 | .50 | 310 | 1.50 | 950 | 2.50 | 1,960 |
| −0.40 | 29 | .60 | 356 | 1.60 | 1,035 | 2.60 | 2,075 |
| −0.30 | 47 | .70 | 406 | 1.70 | 1,125 | 2.70 | 2,190 |
| −0.20 | 68 | .80 | 460 | 1.80 | 1,220 | 2.80 | 2,310 |
| −0.10 | 92 | .90 | 518 | 1.90 | 1,320 | 2.90 | 2,435 |
| .00 | 120 | 1.00 | 580 | 2.00 | 1,420 | 3.00 | 2,560 |
| .10 | 152 | 1.10 | 646 | 2.10 | 1,525 | 3.10 | 2,690 |
| .20 | 187 | 1.20 | 716 | 2.20 | 1,630 | 3.20 | 2,830 |
| .30 | 225 | 1.30 | 790 | 2.30 | 1,740 | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–05. It is well defined between gage heights 1.3 feet and 2.5 feet.

*Estimated monthly discharge of Bear River near Collinston, Utah, for 1905.*

[Drainage area, 6,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,420 | 1,035 | 1,199 | 73,720 | 0.200 | 0.231 |
| February | 1,420 | 790 | 1,199 | 66,590 | .200 | .208 |
| March | 1,960 | 1,320 | 1,605 | 98,690 | .268 | .309 |
| April | 2,075 | 1,525 | 1,800 | 107,100 | .300 | .335 |
| May | 2,760 | 1,850 | 2,201 | 135,300 | .367 | .423 |
| June | 1,685 | 310 | 895 | 53,260 | .149 | .166 |
| July | 120 | 15 | 36.4 | 2,238 | .0061 | .0070 |
| August | 22 | 10 | 13.0 | 779 | .0022 | .0025 |
| September | 406 | 15 | 158 | 9,402 | .026 | .029 |
| October | 1,035 | 646 | 806 | 49,560 | .134 | .154 |
| November | 1,035 | 909 | 976 | 58,080 | .163 | .182 |
| December | 950 | 580 | 767 | 47,160 | .128 | .148 |
| The year | 2,760 | 10 | 971 | 701,900 | .160 | 2.17 |

NOTE.—Discharge interpolated on days when gage was not read. Discharge applied for open channel during winter months.

## LOGAN RIVER NEAR LOGAN, UTAH.

Logan River rises on the west slope of the Bear River Range, flows southwest, then northwest, and unites with Bear River near Benson, Utah. The entire basin is rough and rugged, the elevations ranging from 4,500 to 9,000 feet and the stream being confined largely to a steep and rough channel in a comparatively narrow canyon. The principal formation is a compact limestone, with little or no soil except near the summit of the range, where a thin layer supports quite extensive groves of fir and aspen. The lower reaches of the stream are practically barren of timber, except for a few scattered pine and mahogany trees and a rather thick growth of underbrush. A large amount of timber has been cut out and the area has been overgrazed by sheep and cattle. There are no flood basins or marshes in the region. Probably three-fourths of the precipitation in the basin is snow, the melting of which forms the chief source of supply for the spring and early summer flow; the late summer and winter flow is derived chiefly from springs, which are well distributed over the basin. In its upper course the stream has numerous small tributaries, all short and swift. Temple Fork and South Fork, which enter the river about 10 and 15 miles, respectively, above the gaging station, are perennial streams and furnish from one-third to one-fourth of the total flow. Blacksmith Fork comes in below the gaging station. There is no storage on the stream at present. The entire flow, after being utilized to furnish power at two electric plants near the mouth of the canyon, is used for irrigation.

A gaging station was established June 1, 1896, about 2 miles east of the city of Logan, near the mouth of the canyon. It was discontinued July 18, 1903, and reestablished April 13, 1904, at a point along the canyon road about 50 feet below the highway bridge, at the mouth of the canyon, 800 feet below the Hercules power house and about 1,000 feet above the old gaging station.

Th channel is straight for about 150 feet above and 75 feet below the gaging section. The banks are of rock and soil, permanent, and are sufficiently high to prevent overflow. The bed of the stream was originally of bowlders and gravel, well cemented together, very rough, and of such shape that the stream was not well distributed. When the station was reestablished the channel was improved by removing large bowlders and sufficient of the finer material to distribute the flow and render the bed comparatively smooth. During the spring flood of 1904 a deposit of bowlders and gravel was made at the section, reducing it to about the original conditions, but leaving a loose and probably shifting bed. There is but one channel at all stages. Discharge ranges from about 150 to 1,000 second-feet, with a velocity of from 3 to 7 feet per second. The depth is 1.5 to 3.5 feet. There are no dams or riffles and the grade of the stream is about uniform. Winter flow is affected but little by ice, as the stream never freezes over.

Discharge measurements are made by means of a cable and car of the regular form. The cable is marked at 4-foot intervals with red paint. A guy line is stretched about 25 feet above the cable, for use during high water. The initial point for soundings is a 4 by 4 inch post, set in the west bank and projecting about 4 feet above the ground.

Observations are taken by the Telluride Power Company, under the direction of E. P. Bacon, manager. The gage is of the vertical type, consisting of a 2 by 2½ inch steel rod, with the upstream side drawn to an edge. It is driven into the bed of the stream and is supported at the top by a horizontal 4 by 4 inch fir buried in the bank and fastened to a vertical post near the water edge. The bench mark is a United States Geological Survey standard metallic plug, cemented in a limestone ledge 250 feet N. about 30° W. of the cable. on a prominent point near the north side of a road leading to the power house; elevation, 24.85 feet above zero of gage; elevation above mean sea level, as determined from Oregon Short Line Railroad elevations, 4,502 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 316–317; 19. iv, p 433; 20, iv, p 462; 21, iv, p 397; WS 16, p 158; 28, p 146; 38, p 334; 51, p 411; 66, p 118; 85, pp 86–87; 100, p 137; 133, p 246.
Discharge: Ann 18, iv, p 317; WS 16, p 158; 28, p 153; 38, p 335; 51, p 411; 66, p 118; 85, p 87; 100, p 137; 133, p 246.
Discharge, monthly: Ann 18, iv, p 318; 19, iv, p 434; 20, iv, p 462; 21, iv, p 397; 22, iv, p 408; WS 75, p 192; 133, p 248.
Discharge, yearly: Ann 20, iv, p 60.
Gage heights: WS 11, p 77; 16, p 158; 28, p 150; 38, p 335; 51, p 412; 66, p 119; 100, p 138; 133, pp 247, 248.
Hydrographs: Ann 19, iv, p 434; 20, iv, p 463; 22, iv, p 409.
Rating tables: Ann 18, iv, p 318; 19, iv, p 433; WS 28, p 154; 39, p 453; 52, p 521; 66, p 176; 133, p 247.

*Discharge measurements of Logan River near Logan, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 22 | W. G. Swendsen | 51 | 49 | 3.16 | 4.40 | 155 |
| February 21 | do | 50 | 49 | 3.26 | 4.45 | 160 |
| March 21 | do | 51 | 52 | 2.57 | 4.40 | 134 |
| April 17 | do | 51 | 58 | 3.02 | 4.50 | 175 |
| June 5 | do | 57 | 109 | 5.86 | 5.61 | 637 |
| August 21 | W. D. Beers | 52 | 56 | 2.79 | 4.55 | 155 |
| August 24 [a] | do | 39 | 59 | 2.53 | 4.48 | 149 |
| September 14 | W. G. Swendsen | 51 | 50 | 3.20 | 4.52 | 161 |
| October 29 | do | 51 | 43 | 2.89 | 4.40 | 124 |
| November 26 | do | 51 | 42 | 3.02 | 4.37 | 126 |

[a] Measured 300 feet below station.

*Daily gage height, in feet, of Logan River near Logan, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.45 | 4.48 | 4.4 | 4.43 | 4.9 | 5.5 | 5.1 | 4.59 | 4.5 | 4.43 | 4.4 | 4.33 |
| 2 | 4.4 | 4.48 | 4.38 | 4.41 | 4.95 | 5.5 | 5.05 | 4.6 | 4.5 | 4.43 | 4.4 | 4.31 |
| 3 | 4.4 | 4.53 | 4.38 | 4.41 | 4.9 | 5.55 | 5.05 | 4.57 | 4.5 | 4.43 | 4.4 | 4.32 |
| 4 | 4.4 | ....... | 4.4 | 4.41 | 4.85 | 5.55 | 5.05 | 4.57 | 4.5 | 4.4 | 4.4 | 4.31 |
| 5 | 4.4 | 4.5 | 4.4 | 4.41 | 4.75 | 5.57 | 5.0 | 4.57 | 4.52 | 4.4 | 4.4 | 4.25 |
| 6 | 4.4 | 4.4 | 4.4 | 4.4 | 4.7 | 5.58 | 4.95 | 4.57 | 4.52 | 4.4 | 4.4 | 4.25 |
| 7 | 4.4 | 4.4 | 4.4 | 4.45 | 4.75 | 5.45 | 4.9 | 4.57 | 4.53 | 4.4 | 4.4 | 4.25 |
| 8 | 4.4 | 4.4 | 4.4 | 4.45 | 4.8 | 5.5 | 4.85 | 4.57 | 4.5 | 4.42 | 4.4 | 4.25 |
| 9 | 4.4 | 4.4 | 4.42 | 4.48 | 4.85 | 5.5 | 4.8 | 4.57 | 4.48 | 4.45 | 4.4 | 4.25 |
| 10 | 4.4 | 4.4 | 4.42 | 4.46 | 4.75 | 5.5 | 4.75 | 4.56 | 4.48 | 4.45 | 4.4 | 4.27 |
| 11 | 4.4 | 4.4 | 4.42 | 4.5 | 4.8 | 5.5 | 4.7 | 4.56 | 4.48 | 4.45 | 4.4 | 4.33 |
| 12 | 4.35 | 4.25 | ....... | 4.47 | 4.8 | 5.5 | 4.7 | 4.56 | 4.48 | 4.43 | 4.4 | 4.33 |
| 13 | 4.35 | 4.28 | 4.42 | 4.46 | 4.8 | 5.45 | 4.67 | 4.56 | 4.47 | 4.43 | 4.4 | 4.36 |
| 14 | 4.45 | 4.3 | 4.42 | 4.5 | 4.85 | 5.45 | 4.65 | 4.56 | 4.47 | 4.43 | 4.38 | 4.32 |
| 15 | 4.43 | 4.35 | 4.42 | 4.45 | 4.75 | 5.4 | 4.65 | 4.55 | 4.47 | 4.43 | 4.38 | 4.35 |
| 16 | 4.44 | 4.38 | 4.48 | 4.49 | 4.85 | 5.4 | 4.65 | 4.55 | 4.5 | 4.43 | 4.38 | 4.38 |
| 17 | 4.43 | 4.35 | 4.48 | 4.47 | 4.93 | 5.35 | 4.65 | 4.54 | 4.45 | 4.43 | 4.38 | 4.3 |
| 18 | 4.43 | 4.3 | 4.47 | 4.48 | 5.3 | 5.2 | 4.65 | 4.54 | 4.45 | 4.45 | 4.35 | 4.35 |
| 19 | 4.43 | 4.35 | 4.45 | 4.5 | 5.3 | 5.2 | 4.65 | 4.55 | 4.47 | 4.45 | 4.35 | 4.38 |
| 20 | 4.43 | 4.3 | 4.47 | 4.5 | 5.3 | 5.1 | 4.65 | 4.54 | 4.47 | 4.45 | 4.35 | 4.35 |
| 21 | 4.43 | 4.3 | 4.41 | 4.55 | 5.3 | 5.1 | 4.65 | 4.5 | 4.46 | 4.43 | 4.35 | 4.38 |
| 22 | 4.45 | ....... | 4.45 | 4.55 | 5.25 | 5.07 | 4.65 | 4.54 | 4.45 | 4.43 | 4.33 | 4.38 |
| 23 | 4.45 | 4.38 | 4.4 | 4.65 | 5.25 | 5.1 | 4.65 | 4.5 | 4.45 | 4.42 | 4.35 | 4.33 |
| 24 | 4.47 | 4.4 | 4.45 | 4.65 | 5.2 | 5.1 | 4.65 | 4.48 | 4.45 | 4.42 | 4.35 | 4.35 |
| 25 | 4.45 | 4.38 | 4.43 | 4.65 | 5.25 | 5.1 | 4.6 | 4.5 | 4.48 | 4.42 | 4.35 | 4.35 |
| 26 | 4.45 | 4.3 | ....... | 4.7 | 5.3 | 5.1 | 4.6 | 4.5 | 4.49 | 4.4 | 4.32 | 4.4 |
| 27 | 4.43 | 4.38 | 4.42 | 4.8 | 5.3 | 5.1 | 4.6 | 4.48 | 4.47 | 4.4 | 4.29 | 4.38 |
| 28 | 4.43 | 4.38 | 4.45 | 4.8 | 5.35 | 5.1 | 4.6 | 4.5 | 4.47 | 4.4 | 4.4 | 4.38 |
| 29 | 4.43 | ....... | 4.45 | 4.75 | 5.3 | 5.1 | 4.6 | 4.5 | 4.47 | 4.4 | 4.38 | 4.38 |
| 30 | 4.43 | ....... | 4.45 | 4.8 | 5.3 | 5.1 | 4.6 | 4.45 | 4.45 | 4.4 | 4.3 | 4.35 |
| 31 | 4.43 | ....... | 4.45 | ....... | 5.35 | ....... | 4.6 | 4.5 | ....... | 4.4 | ....... | 4.38 |

NOTE.—Stream does not freeze at this point during winter months in sufficient amount to materially affect the rating.

*Station rating table for Logan River near Logan, Utah, from April 25, 1904, to December 31, 1905.*

| Gage height | Discharge | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.30 | 109 | 5.00 | 350 | 5.70 | 675 | 6.40 | 1,052 |
| 4.40 | 136 | 5.10 | 394 | 5.80 | 726 | 6.50 | 1,108 |
| 4.50 | 164 | 5.20 | 438 | 5.90 | 779 | 6.60 | 1,164 |
| 4.60 | 195 | 5.30 | 483 | 6.00 | 833 | 6.70 | 1,222 |
| 4.70 | 230 | 5.40 | 529 | 6.10 | 887 | 6.80 | 1,280 |
| 4.80 | 268 | 5.50 | 577 | 6.20 | 941 | 6.90 | 1,338 |
| 4.90 | 308 | 5.60 | 625 | 6.30 | 996 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 21 discharge measurements made during 1904–1905. It is fairly well defined between gage heights 4.4 feet and 6.25 feet.

*Estimated monthly discharge of Logan River near Logan, Utah, for 1905.*

[Drainage area, 218 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 155 | 122 | 142 | 8,731 | 0.651 | 0.750 |
| February | 173 | 96 | 131 | 7,275 | .601 | .626 |
| March | 157 | 131 | 144 | 8,854 | .661 | .762 |
| April | 268 | 139 | 177 | 10,530 | .812 | .906 |
| May | 506 | 230 | 368 | 22,630 | 1.69 | 1.95 |
| June | 615 | 382 | 496 | 29,510 | 2.28 | 2.54 |
| July | 394 | 195 | 248 | 15,250 | 1.14 | 1.31 |
| August | 195 | 150 | 176 | 10,820 | .807 | .930 |
| September | 173 | 150 | 158 | 9,402 | .725 | .809 |
| October | 150 | 136 | 143 | 8,793 | .656 | .756 |
| November | 136 | 106 | 129 | 7,676 | .592 | .660 |
| December | 136 | 96 | 118 | 7,256 | .541 | .624 |
| The year | 615 | 96 | 202 | 146,700 | .930 | 12.62 |

NOTE.—Discharge interpolated on days when gage was not read.

## BLACKSMITH FORK NEAR HYRUM, UTAH.

This stream rises on the western slope of the Bear River Range and flows southwest and then northwest into Logan River. The drainage basin of the tributary is in every way similar to that of the main stream. Only the flood and winter discharge, however, reaches the Logan, the entire spring and summer flow being used for irrigation on the tillable lands below the gaging station.

The gaging station was established July 19, 1900, near the tollgate in the mouth of the canyon near Hyrum, Utah, which is the nearest post-office. The station was discontinued December 31, 1902, and reestablished May 16, 1904, about 1,000 feet downstream from the tollgate and 800 feet above the Hyrum city electric-power plant. A station is also maintained at the power-plant race.

The channel is straight for 200 feet above and 50 feet below the station. The right bank for 20 feet back is a low, wooded flat, subject to overflow during extreme high water; beyond this point the bank is high and barren. The left bank is wooded and high and does not overflow. The bed of the stream is composed of bowlders and gravel and is somewhat rough, but apparently permanent, though a slight change seems to have occurred during December, 1904. During flood stages the velocity is high, ranging from 4 to 6 feet per second; under normal conditions it is 2 to 3 feet per second. The discharge varies from about 80 to 1,000 second-feet. Ice does not form in sufficient quantity to interfere with the results at any stage.

Discharge measurements are made by means of a cable and car of regular form. The cable is marked at 4-foot intervals with red paint. A guy line for use during high water is stretched across the stream about 30 feet above the cable. The initial point for soundings is the south post supporting the cable.

The gage, which is observed daily by Uriah Benson, a farmer living at the tollgate, is of the vertical type, and consists of a 2 by 2½ inch iron bar with the upstream side drawn to an edge, driven into the bed of the stream and supported by a horizontal piece buried in the bank. The gage is referred to bench marks as follows: (1) A United States Geological Survey standard metallic plug, set in a solid limestone ledge about 40 feet east of the north post supporting the cable; elevation above zero of gage, 17.875 feet. (2) Top of the eyebolt of the north anchor of the cable; elevation above zero of gage, 9.578 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 51, p 412; 66, p 119; 85, p 84, 133; p 249.
Discharge: WS 51, p 412; 66, p 119; 85, p 85; 133, p 249.
Discharge, monthly: Ann 22, iv, p 409; WS 75, p 192; 85, p 86; 133, p 251.
Gage heights: WS 51, p 413; 66, p 120; 85, p 85; 133, p 250.
Hydrograph: Ann 22, iv, p 410.
Rating tables: WS 52, p 521; 66, p 176; 85, p 86; 133, p 250.

*Discharge measurements of Blacksmith Fork near Hyrum, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 23 | W. G. Swendsen | 38 | 35 | 2.26 | 3.50 | 78 |
| February 22 | do | 38 | 34 | 2.32 | 3.50 | 80 |
| April 16 | do | 39 | 44 | 2.72 | 3.70 | 119 |
| May 4 | do | 41 | 58 | 3.18 | 3.98 | 186 |
| July 9 | do | 39 | 41 | 2.29 | 3.60 | 95 |
| August 22 | W. D. Beers | 37 | 39 | 1.91 | 3.60 | 77 |
| October 28 | W. G. Swendsen | 30 | 23 | 1.23 | 3.30 | 28 |
| November 27 | do | 30 | 23 | 1.33 | 3.31 | 31 |

*Daily gage height, in feet, of Blacksmith Fork near Hyrum, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 2 | 3.5 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 3 | 3.5 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 4 | 3.5 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 5 | 3.5 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 6 | 3.4 | 3.5 | 3.5 | 3.6 | 3.9 | 3.9 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 7 | 3.4 | 3.5 | 3.5 | 3.6 | 3.9 | 3.9 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 8 | 3.5 | 3.5 | 3.5 | 3.7 | 3.9 | 3.9 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 9 | 3.5 | 3.4 | 3.5 | 3.7 | 3.9 | 3.9 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 10 | 3.5 | 3.4 | 3.5 | 3.6 | 3.9 | 3.8 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.3 |
| 11 | 3.5 | 3.4 | 3.5 | 3.6 | 3.9 | 3.8 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.2 |
| 12 | 3.5 | 3.4 | 3.5 | 3.6 | 3.9 | 3.8 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.2 |
| 13 | 3.5 | 3.4 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.2 |
| 14 | 3.5 | 3.5 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.6 | 4.8 | 3.6 | 3.3 | 3.2 |
| 15 | 3.5 | 3.5 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.2 |
| 16 | 3.5 | 3.5 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 |
| 17 | 3.5 | 3.5 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 |
| 18 | 3.5 | 3.5 | 3.5 | 3.7 | 4.0 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 |
| 19 | 3.5 | 3.5 | 3.5 | 3.8 | 4.0 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.2 |
| 20 | 3.5 | 3.5 | 3.5 | 3.8 | 4.0 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.2 |
| 21 | 3.5 | 3.5 | 3.5 | 3.8 | 4.0 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.3 | 3.2 |
| 22 | 3.5 | 3.5 | 3.5 | 3.8 | 4.0 | 3.8 | 3.6 | 3.6 | 3.6 | 3.5 | 3.3 | 3.3 |
| 23 | 3.5 | 3.4 | 3.6 | 3.9 | 4.1 | 3.8 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 24 | 3.5 | 3.4 | 3.6 | 3.9 | 4.1 | 3.8 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 25 | 3.5 | 3.4 | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 26 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 27 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 28 | 3.5 | 3.5 | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 29 | 3.5 | ....... | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 30 | 3.5 | ....... | 3.6 | 4.0 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.3 | 3.3 | 3.3 |
| 31 | 3.5 | ....... | 3.6 | ....... | 4.1 | ....... | 3.6 | 4.8 | ....... | 3.3 | ....... | 3.3 |

NOTE.—Stream does not freeze at this point during the winter months in sufficient quantity to materially affect the rating.

*Station rating table for Blacksmith Fork near Hyrum, Utah, from January 1 to July 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet* | *Second-feet* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 64 | 3.60 | 98 | 3.80 | 140 | 4.00 | 190 |
| 3.50 | 80 | 3.70 | 118 | 3.90 | 164 | 4.10 | 216 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during January to July, 1905. It is well defined throughout.

*Station rating table for Blacksmith Fork near Hyrum, Utah, from August 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 18 | 3.70 | 94 | 4.10 | 189 | 4.50 | 304 |
| 3.30 | 29 | 3.80 | 115 | 4.20 | 216 | 4.60 | 336 |
| 3.40 | 42 | 3.90 | 138 | 4.30 | 244 | 4.70 | 369 |
| 3.50 | 57 | 4.00 | 163 | 4.40 | 273 | 4.80 | 402 |
| 3.60 | 75 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during August to December, 1905, and the form of the 1904 curve. It is well defined between gage heights 3.2 feet and 4 feet.

*Estimated monthly discharge of Blacksmith Fork near Hyrum, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 80 | 64 | 79.0 | 4,858 |
| February | 80 | 64 | 75.4 | 4,188 |
| March | 98 | 80 | 85.2 | 5,239 |
| April | 190 | 98 | 132. | 7,855 |
| May | 216 | 164 | 187. | 11,500 |
| June | 216 | 118 | 151. | 8,985 |
| July | 98 | 98 | 98.0 | 6,026 |
| August | 402 | 75 | 85.5 | 5,257 |
| September | 402 | 75 | 228. | 13,570 |
| October | 75 | 29 | 61.1 | 3,757 |
| November | 29 | 29 | 29.0 | 1,726 |
| December | 29 | 18 | 26.2 | 1,611 |
| The year | 402 | 18 | 103 | 74,570 |

NOTE.—Above estimates do not represent total flow of river. See Blacksmith Fork power plant race (pp. 34-35).

## BLACKSMITH FORK POWER PLANT RACE, NEAR HYRUM, UTAH.

This station was established May 16, 1904, for the purpose of ascertaining the amount of water diverted around the regular gaging station at the tollgate and thus determining the total flow of the stream at that point. It is located about 600 feet down the canyon road from the tollgate at the mouth of the canyon, about 200 feet below the head of the canal or race, and about 500 feet south of the river station.

The channel is straight for 100 feet above and 200 feet below the station. Both banks are sufficiently high to prevent overflow. The bed of the stream is of gravel and is apparently permanent, except for probable slight changes near the edges. The depth varies from 2 to 3 feet and the velocity from 2 to 3 feet per second. Practically no ice forms in the channel at any time.

Discharge measurements are made from a foot plank placed across the stream and fastened at the ends to pieces of timber buried in the bank. The plank is marked at 1-foot intervals. The initial point for soundings is the north end of the plank, marked zero.

The gage, daily readings of which are made by Uriah Benson, is a 2 by 2½ inch iron bar driven vertically into the bed of the stream, supported at the top by the plank from which the measurements are made, and graduated by means of punch holes. The bench mark is a point on a projecting rock on the southeast corner of a rock house about 400 feet northwest from the station. It is marked with red paint. Elevation above zero of gage, 8.845 feet.

A description of this station, gage height, and discharge data and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 251–253.

*Discharge measurements of Blacksmith Fork power plant race, near Hyrum, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 23 | W. G. Swendsen | 12.0 | 23 | 2.55 | 4.50 | 58 |
| October 28 | do | 13.5 | 28 | 3.02 | 4.90 | 83 |

*Daily gage height, in feet, of Blacksmith Fork power plant race near Hyrum, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 2 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 3 | 4.5 | 4.5 | 4.6 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 4 | 4.45 | 4.5 | 4.6 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 5 | 4.45 | 4.5 | 4.5 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 6 | 4.45 | 4.5 | 4.5 | 4.6 | 4.5 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 7 | 4.45 | 4.5 | 4.5 | 4.6 | 4.4 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 8 | 4.45 | 4.5 | 4.5 | 4.6 | 4.4 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 9 | 4.45 | 4.4 | 4.5 | 4.6 | 4.4 | 4.6 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 10 | 4.5 | 4.4 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.9 |
| 11 | 4.5 | 4.4 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.5 |
| 12 | 4.5 | 4.4 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.5 |
| 13 | 4.5 | 4.4 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.5 |
| 14 | 4.5 | 4.5 | 4.5 | 4.6 | 4.4 | 4.5 | 4.6 | 4.6 | ....... | 4.4 | 4.9 | 4.5 |
| 15 | 4.5 | 4.5 | 4.5 | 4.7 | 4.4 | 4.5 | 4.6 | 4.6 | 4.5 | 4.4 | 4.9 | 4.6 |
| 16 | 4.5 | 4.5 | 4.5 | 4.7 | 4.4 | 4.4 | 4.6 | 4.6 | 4.5 | 4.4 | 4.9 | 4.7 |
| 17 | 4.5 | 4.45 | 4.5 | 4.7 | 4.4 | 4.4 | 4.6 | 4.6 | 4.5 | 4.4 | 4.9 | 4.6 |
| 18 | 4.5 | 4.45 | 4.5 | 4.7 | 4.5 | 4.4 | 4.6 | 4.6 | 4.4 | 4.4 | 4.9 | 4.6 |
| 19 | 4.5 | 4.45 | 4.5 | 4.8 | 4.5 | 4.4 | 4.6 | 4.5 | 4.4 | 4.4 | 4.9 | 4.5 |
| 20 | 4.5 | 4.45 | 4.5 | 4.8 | 4.5 | 4.4 | 4.6 | 4.5 | 4.4 | 4.4 | 4.9 | 4.5 |
| 21 | 4.5 | 4.45 | 4.5 | 4.8 | 4.5 | 4.4 | 4.6 | 4.5 | 4.4 | 4.4 | 4.9 | 4.5 |
| 22 | 4.5 | 4.45 | 4.5 | 4.8 | 4.5 | 4.4 | 4.6 | 4.5 | 4.4 | 4.7 | 4.9 | 4.6 |
| 23 | 4.5 | 4.45 | 4.6 | 4.5 | 4.5 | 4.4 | 4.6 | 4.4 | 4.4 | 4.9 | 4.9 | 4.6 |
| 24 | 4.5 | 4.45 | 4.6 | 4.5 | 4.6 | 4.4 | 4.6 | 4.4 | 4.4 | 4.9 | 4.9 | 4.7 |
| 25 | 4.5 | 4.45 | 4.6 | 4.5 | 4.6 | 4.6 | 4.6 | 4.4 | 4.4 | 4.9 | 4.9 | 4.7 |
| 26 | 4.5 | 4.45 | 4.6 | 4.5 | 4.6 | 4.6 | 4.6 | 4.3 | 4.4 | 4.9 | 4.9 | 4.7 |
| 27 | 4.5 | 4.45 | 4.6 | 4.5 | 4.6 | 4.6 | 4.6 | 4.3 | 4.4 | 4.9 | 4.9 | 4.8 |
| 28 | 4.5 | 4.5 | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | 4.3 | 4.4 | 4.9 | 4.9 | 4.8 |
| 29 | 4.5 | ....... | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | 4.3 | 4.4 | 4.9 | 4.9 | 4.8 |
| 30 | 4.5 | ....... | 4.5 | 4.5 | 4.6 | 4.6 | 4.6 | 4.3 | 4.4 | 4.9 | 4.9 | 4.8 |
| 31 | 4.5 | ....... | 4.5 | ....... | 4.6 | ....... | 4.6 | ....... | ....... | 4.9 | ....... | 4.8 |

NOTE.—Flow not materially affected by ice conditions.

*Station rating table for Blacksmith Fork power plant race near Hyrum, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.30 | 44 | 4.50 | 58 | 4.70 | 73 | 4.90 | 88 |
| 4.40 | 51 | 4.60 | 66 | 4.80 | 80 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904-5. It is fairly well defined.

*Estimated monthly discharge of Blacksmith Fork power plant race near Hyrum, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 58 | 54 | 57.2 | 3,517 |
| February | 58 | 51 | 55.2 | 3,066 |
| March | 66 | 58 | 59.8 | 3,677 |
| April | 80 | 58 | 65.3 | 3,886 |
| May | 66 | 51 | 57.6 | 3,542 |
| June | 66 | 51 | 59.9 | 3,564 |
| July | 66 | 66 | 66.0 | 4,058 |
| August 1-30 | 66 | 44 | 59.8 | 3,558 |
| September 15-30 | 58 | 51 | 52.3 | 1,659 |
| October | 88 | 51 | 62.5 | 3,843 |
| November | 88 | 88 | 88.0 | 5,236 |
| December | 88 | 58 | 74.5 | 4,581 |
| The year | 88 | 51 | 63.2 | 44,190 |

## WEBER RIVER BASIN.

### DESCRIPTION OF BASIN.

Weber River rises on the northern slope of the Uinta Mountains and flows in a tortuous course northwestward into Great Salt Lake.

The upper portion of the basin is very rough. The highest peaks, reaching an elevation of about 13,000 feet, are masses of sandstone and quartzite, entirely barren of vegetation and covered with snow for almost the entire year. Farther down the prevailing formation is limestone, overlain with sandstone and conglomerate. A thin layer of soil covers the basin in patches and supports small groves of fir and aspen. There are no extensive forests, meadows, or marshes. The greater part of the precipitation is in the form of snow, the melting of which is the chief source of the spring flood and early summer flow. A large part of the normal flow is derived from springs, which are well distributed over the area. Numerous tributaries, all short and confined to steep, narrow canyons, enter all along the course.

Between Oakley and Croyden the river traverses a very narrow valley comprising irrigated farms. The principal formation over this area is of conglomerate and sandstone, with but little loose and porous overlying soil except near the stream bed, where the deposit of bowlders and soil ranges from 10 to 20 feet in depth. The chief tributaries in this stretch of the river are Beaver Creek, which enters from the south about 6 miles below Oakley and drains a rough country about 71 square miles in extent; Chalk Creek, from the east, which drains a rough, dry country, about 248 square miles in area, and enters the Weber 15 miles above Croyden; and Lost Creek, which comes in from the east at a point about one-half mile above the Devils Slide gaging station and has a watershed of 205 square miles. Gaging stations are maintained near the mouth of Chalk and Lost creeks.

Between Croyden and Plain City the stream flows in a well-defined channel through a comparatively narrow, steep canyon, with occasional stretches of narrow valley containing irrigated farming lands. The rock is a porous and badly fissured sandstone and conglomerate, with but little overlying soil. Near the mouth of the canyon the material is a very rough but compact limestone. East Creek, which enters near Morgan, discharges but little water into the river, as its flow is completely controlled by a storage reservoir about 5 miles above its mouth, the water being used for irrigation in the Morgan Valley, through which the Weber flows. After leaving the Wasatch Range the Weber enters the Great Salt Lake Valley, through which it flows in a well-defined channel with no overflow.

Ogden River joins the Weber about 8 miles above Plain City. It drains a rough and rugged limestone area, 363 square miles in extent, in the western slopes of the Wasatch Range. The main stream and its numerous short tributaries are confined to steep, narrow canyons. The entire normal flow of the stream is diverted for irrigation near the foot of the canyon about 3 miles above the mouth of the river, after being used for the development of power by the Utah Light and Railway Company. The flood and winter flow, therefore, is all that reaches the Weber, except for a small amount of seepage from the irrigated district. The city of Ogden also derives its water supply from Ogden River.

There are at present no storage reservoirs on the Weber, but a number of possibilities exist.

## WEBER RIVER NEAR OAKLEY, UTAH.

This station was established October 22, 1904. It is located approximately 200 feet south of the main canyon road, about 3 miles above Oakley, Utah, and is above all diversions to the Kamas prairie region. The object of the station is to determine the amount of water available for diversion through the low Kamas Pass into Provo River, which is a part of the reclamation scheme in the development of the Weber River project.

Except for a slight depression, which probably carries a small amount of water during extreme floods, there is but one channel at all stages. The right bank for about 200 feet from the main channel is a low, wooded bottom, and is liable to overflow at extreme high water; the left bank is high and wooded. The bed of the stream, which is composed of large bowlders, gravel, and soil, is very rough, but thus far has been found to be permanent. Ice forms during December and January to a sufficient extent to render open-channel curves useless. The flow, which ranges from about 75 to 1,000 second-feet, reaches a maximum during May and a minimum during the winter months. The velocity ranges from 4 to 7 feet per second.

Discharge measurements are made by means of a cable and car. The cable is marked at 4-foot intervals with paint, the anchor bolt which supports the cable on the left bank being the initial point. A guy line stretched across the stream about 40 feet above the gaging section is found useful at all stages.

The gage, which is read daily by John Franson, a farmer, is of the inclined type and consists of three sections of 2-foot by one-half inch iron, fastened to the solid limestone ledge by means of bolts set in cement. It is graduated with chisel marks and paint to read vertically. The bench mark is a United States Geological Survey standard metallic plug, set in the ledge 0.5 foot from the anchor bolt used as initial point for soundings; elevation above zero of gage, 14.79 feet.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 253–254.

*Discharge measurements of Weber River near Oakley, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 9 | W. G. Swendsen | 41 | 55 | 1.13 | 4.10 | 63 |
| March 9 | do | 41 | 55 | 1.17 | 4.10 | 65 |
| May 1 | do | 47 | 91 | 2.65 | 4.92 | 243 |
| June 16 | do | 51 | 137 | 5.75 | 6.00 | 787 |
| June 27 | do | 49 | 116 | 3.34 | 5.30 | 389 |
| August 8 | C. Tanner | 42 | 57 | 1.26 | 4.20 | 72 |
| August 18 | W. D. Beers | 42 | 62 | 1.10 | 4.18 | 68 |

*Daily gage height, in feet, of Weber River near Oakley, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.05 | 4.1 | 4.15 | 4.95 | 6.0 | 5.0 | 4.3 | 4.05 | 4.35 | 4.15 | 4.05 |
| 2 | | | | 4.15 | 5.05 | 6.15 | 4.95 | 4.3 | 4.05 | 4.3 | 4.15 | 4.0 |
| 3 | | | | 4.2 | 5.05 | 6.3 | 4.9 | 4.3 | 4.05 | 4.3 | 4.15 | 4.0 |
| 4 | 5.4 | | | 4.25 | 4.9 | 6.4 | | 4.3 | 4.05 | 4.25 | 4.15 | 4.0 |
| 5 | | | | 4.3 | 4.8 | 6.45 | 4.8 | 4.3 | 4.05 | 4.25 | 4.15 | |
| 6 | | | | 4.35 | 4.7 | 6.5 | 4.75 | 4.3 | 4.05 | 4.2 | 4.15 | 4.1 |
| 7 | | | | 4.35 | 4.75 | 6.6 | 4.75 | 4.3 | 4.1 | 4.2 | 4.15 | 4.2 |
| 8 | | 4.05 | | 4.4 | 4.8 | 7.0 | 4.7 | 4.2 | 4.1 | 4.2 | 4.1 | |
| 9 | | | 4.1 | 4.4 | 4.8 | 6.8 | 4.7 | 4.2 | 4.1 | 4.2 | 4.1 | 4.8 |
| 10 | | | 4.1 | 4.35 | 4.75 | 6.3 | 4.7 | 4.2 | 4.1 | 4.2 | 4.1 | |
| 11 | 4.7 | | 4.1 | 4.3 | 4.7 | 6.25 | 4.65 | 4.2 | 4.1 | 4.2 | 4.1 | |
| 12 | | | 4.15 | 4.3 | 4.7 | 6.3 | 4.65 | 4.2 | 4.1 | 4.2 | 4.1 | |
| 13 | | | 4.15 | 4.3 | 4.7 | 6.3 | 4.6 | 4.2 | 4.1 | 4.2 | 4.1 | 5.15 |
| 14 | | | 4.15 | 4.3 | 4.7 | 6.3 | 4.6 | 4.2 | 4.1 | 4.2 | 4.1 | |
| 15 | | 5.1 | 4.15 | 4.35 | 4.7 | 6.25 | 4.65 | 4.15 | 4.1 | 4.2 | 4.1 | |
| 16 | | | 4.15 | 4.35 | 4.8 | 6.0 | | 4.15 | 4.1 | 4.2 | 4.1 | 4.6 |
| 17 | | | 4.15 | 4.35 | 5.0 | 5.9 | 4.55 | 4.15 | 4.1 | 4.2 | 4.1 | |
| 18 | 4.5 | | 4.2 | 4.4 | 5.2 | 5.7 | 4.55 | 4.15 | 4.1 | 4.2 | 4.1 | |
| 19 | | | 4.2 | 4.45 | 5.3 | 5.7 | 4.55 | 4.15 | 4.1 | 4.2 | 4.1 | |
| 20 | | | 4.2 | 4.45 | 5.35 | 5.8 | 4.5 | 4.15 | 4.1 | 4.2 | 4.1 | 4.75 |
| 21 | | | 4.2 | 4.45 | 5.4 | 5.75 | 4.5 | 4.15 | 4.1 | 4.2 | 4.1 | |
| 22 | | 4.3 | 4.2 | 4.45 | 5.65 | 5.75 | 4.5 | 4.1 | 4.1 | 4.2 | 4.1 | |
| 23 | | | 4.15 | 4.55 | 5.7 | 5.7 | 4.5 | 4.1 | 4.1 | 4.2 | 4.1 | 4.85 |
| 24 | | | 4.15 | 4.6 | 5.7 | 5.6 | 4.45 | 4.1 | 4.1 | 4.15 | 4.1 | |
| 25 | 4.05 | | 4.15 | 4.65 | 5.7 | 5.55 | 4.4 | 4.1 | 4.1 | 4.15 | 4.1 | |
| 26 | | | 4.15 | 4.75 | 5.75 | 5.4 | 4.35 | 4.1 | 4.1 | 4.1 | 4.1 | |
| 27 | | | 4.15 | 4.8 | 5.75 | 5.35 | 4.35 | 4.1 | 4.1 | 4.1 | 4.1 | 5.25 |
| 28 | | | 4.15 | 4.85 | 5.75 | 5.35 | 4.3 | 4.1 | | 4.1 | 4.1 | |
| 29 | | | 4.15 | 4.9 | 5.8 | 5.2 | 4.3 | 4.1 | 4.2 | 4.15 | 4.1 | |
| 30 | | | 4.15 | 4.9 | 5.85 | 5.1 | 4.3 | 4.1 | 4.35 | 4.15 | 4.1 | 5.1 |
| 31 | | | 4.15 | | 5.85 | | 4.3 | 4.1 | | 4.15 | | |

NOTE.—Ice conditions January, February, and December noted on observer's records as follows:
January 4, ice at banks; river open in the center.
January 11, ice 1 foot thick at banks; 0.5 foot thick in the center.
January 18, ice broken up.
January 25, river clear.
February 1, river clear.
February 8, ice at banks; river open in the center.
February 15, ice 0.5 foot thick at banks; 0.25 foot thick in the center.
February 22, ice broken up.

March 1, river clear.

December 2, ice 0.3 foot thick at banks.

The following thicknesses of ice were recorded during December:

|  | Feet. |  | Feet. |
|---|---|---|---|
| December 9 | 0.7 | December 23 | 0.7 |
| December 13 | .5 | December 27 | .8 |
| December 16 | .6 | December 30 | 1.15 |
| December 20 | .6 |  |  |

Observer reports no anchor ice during December.

Gage readings during December are to the surface of the water in a hole cut in the ice.

*Station rating table for Weber River near Oakley, Utah, from October 23, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.00 | 46 | 4.80 | 209 | 5.60 | 542 | 6.40 | 1,066 |
| 4.10 | 58 | 4.90 | 241 | 5.70 | 597 | 6.50 | 1,145 |
| 4.20 | 73 | 5.00 | 275 | 5.80 | 655 | 6.60 | 1,227 |
| 4.30 | 90 | 5.10 | 312 | 5.90 | 716 | 6.70 | 1,312 |
| 4.40 | 109 | 5.20 | 352 | 6.00 | 780 | 6.80 | 1,400 |
| 4.50 | 130 | 5.30 | 395 | 6.10 | 847 | 6.90 | 1,490 |
| 4.60 | 154 | 5.40 | 441 | 6.20 | 917 | 7.00 | 1,580 |
| 4.70 | 180 | 5.50 | 490 | 6.30 | 990 |  |  |

NOTE.—The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1904–5. It is well defined between gage heights 4 feet and 6 feet.

*Estimated monthly discharge of Weber River near Oakley, Utah, for 1904 and 1905.*

| Month. | Discharge in second-feet. |  |  | Total in acre-feet. |
|---|---|---|---|---|
|  | Maximum. | Minimum. | Mean. |  |
| 1904. |  |  |  |  |
| October 23-31 | 82 | 82 | 82.0 | 1,464 |
| November 1-26 | 100 | 66 | 72.1 | 3,718 |
| 1905. |  |  |  |  |
| March | 73 | 58 | 64.3 | 3,954 |
| April | 241 | 66 | 124 | 7,379 |
| May | 686 | 180 | 372 | 22,870 |
| June | 1,580 | 312 | 808 | 48,080 |
| July | 275 | 90 | 156 | 9,592 |
| August | 90 | 58 | 70.4 | 4,329 |
| September | 100 | 52 | 58.9 | 3,505 |
| October | 100 | 58 | 73.0 | 4,488 |
| November | 66 | 58 | 59.9 | 3,564 |
| The period (1905) |  |  |  | 107,800 |

NOTE.—Ice conditions November 27, 1904, to February 28, 1905, and December 2-31, 1905. Discharge interpolated on days when gage was not read.

## WEBER RIVER NEAR CROYDEN, UTAH.

This station was established February 1, 1905. It is located about 1½ miles west of the town of Croyden, one-fourth mile below the junction of Lost Creek and Weber River, about three-fourths mile up the river from Croyden station on the Union Pacific Railroad, and 10 miles down the river from the town of Echo, just below the narrow canyon at the lower end of Henefer Valley.

The station is important as showing the amount of water available for storage in the Henefer basin, about 2 miles above the station, the development of which is a part of the reclamation scheme on the Weber River project. The winter records will be of special value, since the entire winter flow of the stream is at present discharged as waste into Great Salt Lake.

The channel is straight for about 1,000 feet above and 700 feet below the station. Both banks are sloping and sufficiently high to prevent overflow. The bed of the stream is of small, compact gravel and soil and is smooth and permanent. The velocity is moderate and uniform. The stream is shallow, especially during low water, the depth seldom exceeding 3 feet. There is a free flow, no obstruction to gage readings or discharge measurements existing. Information as to winter conditions is as yet rather indefinite.

Discharge measurements are made by means of a cable and car. The cable is marked at 5-foot intervals, the west face of a tree to which the east end of the cable is attached being the initial points for soundings.

The gage, which is read daily by Isaiah Stewart, a farmer who lives about 300 feet from the station, is an inclined piece of 4 by 4 inch fir, fastened to vertical posts near the water's edge and to a large cottonwood tree on the right bank about 75 feet above the cable. It is graduated to read vertically. The gage is referred to bench marks as follows: (1) A 3-inch metal post set 3½ feet in the ground on the bank 20 feet north from the gage; elevation above datum of gage, 8.41 feet; (2) a 30-penny nail driven in the tree which supports the upper end of the gage; elevation above gage datum, 7.87 feet.

Results of discharge measurements at this station are contained in Water-Supply Paper No. 133 of the United States Geological Survey, page 364.

*Discharge measurements of Weber River near Croydon, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 31[a] | W. G. Swendsen | 90 | 95 | 2.04 | 1.90 | 193 |
| March 7 | do | 95 | 126 | 2.67 | 2.22 | 337 |
| May 2 | do | 102 | 192 | 3.73 | 2.85 | 703 |
| June 17 | do | 100 | 213 | 4.10 | 3.05 | 875 |
| June 28 | do | 91 | 113 | 2.45 | 2.10 | 277 |
| August 19 | W. D. Beers | 89 | 56 | .92 | 1.40 | 51 |
| November 16 | W. G. Swendsen | 91 | 88 | 1.76 | 1.75 | 155 |

[a] Measurement made by wading.

*Daily gage height, in feet, of Weber River near Croydon, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.95 | 1.95 | 1.95 | 2.65 | 2.85 | 1.9 | 1.4 | 1.4 | 1.65 | 1.8 | 1.8 |
| 2 | | 1.95 | 1.95 | 2.0 | 2.8 | 3.0 | 1.9 | 1.4 | 1.4 | 1.65 | 1.8 | 1.8 |
| 3 | | 1.95 | 2.0 | 2.0 | 2.75 | 3.1 | 1.85 | 1.4 | 1.45 | 1.65 | 1.8 | 1.85 |
| 4 | | 1.95 | 2.1 | 1.95 | 2.6 | 3.55 | 1.8 | 1.4 | 1.45 | 1.6 | 1.8 | 1.8 |
| 5 | | 1.9 | 2.2 | 1.95 | 2.6 | 3.6 | 1.75 | 1.4 | 1.5 | 1.6 | 1.8 | 1.7 |
| 6 | | 1.9 | 2.1 | 1.95 | 2.55 | 3.35 | 1.7 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 7 | | 1.9 | 2.2 | 1.95 | 2.5 | 3.3 | 1.65 | 1.4 | 1.5 | 1.6 | 1.8 | 1.65 |
| 8 | | 1.9 | 2.1 | 1.95 | 2.45 | 3.9 | 1.6 | 1.4 | 1.5 | 1.6 | 1.8 | 1.7 |
| 9 | | 1.85 | 2.1 | 1.95 | 2.5 | 3.9 | 1.55 | 1.4 | 1.5 | 1.6 | 1.8 | 1.7 |
| 10 | | 1.8 | 2.1 | 2.2 | 2.5 | 3.9 | 1.5 | 1.4 | 1.5 | 1.6 | 1.8 | 1.7 |
| 11 | | 1.8 | 2.1 | 2.3 | 2.4 | 3.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.8 | 1.65 |
| 12 | | 1.65 | 2.1 | 2.25 | 2.4 | 3.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.75 | 1.6 |
| 13 | | 1.65 | 2.05 | 2.2 | 2.4 | 3.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.75 | 1.6 |
| 14 | | 1.65 | 2.05 | 2.15 | 2.35 | 3.45 | 1.5 | 1.4 | 1.5 | 1.6 | 1.75 | 1.6 |
| 15 | | 1.65 | 2.0 | 2.15 | 2.3 | 3.5 | 1.5 | 1.4 | 1.5 | 1.6 | 1.75 | 1.6 |
| 16 | | 1.65 | 2.0 | 2.2 | 2.3 | 3.5 | 1.5 | 1.4 | 1.5 | 1.6 | 1.75 | 1.65 |
| 17 | | 1.8 | 1.95 | 2.25 | 2.3 | 3.0 | 1.55 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 18 | | 1.8 | 2.0 | 2.3 | 2.4 | 2.9 | 1.75 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 19 | | 1.8 | 2.1 | 2.3 | 2.6 | 2.8 | 1.9 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 20 | | 1.8 | 2.05 | 2.4 | 2.7 | 2.7 | 1.9 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 21 | | 1.8 | 2.0 | 2.6 | 2.8 | 2.7 | 1.9 | 1.4 | 1.5 | 1.6 | 1.8 | 1.6 |
| 22 | | 1.8 | 1.95 | 2.4 | 2.95 | 2.65 | 1.9 | 1.4 | 1.5 | 1.7 | 1.85 | 1.5 |
| 23 | | 1.9 | 1.9 | 2.2 | 2.95 | 2.6 | 1.8 | 1.4 | 1.5 | 1.75 | 1.8 | 1.6 |
| 24 | | 1.9 | 1.95 | 2.3 | 2.95 | 2.6 | 1.8 | 1.4 | 1.5 | 1.75 | 1.8 | 1.5 |
| 25 | | 1.95 | 2.0 | 2.3 | 2.9 | 2.4 | 1.8 | 1.4 | 1.5 | 1.75 | 1.8 | 1.6 |
| 26 | | 1.95 | 2.0 | 2.4 | 2.85 | 2.3 | 1.6 | 1.4 | 1.5 | 1.75 | 1.75 | 1.7 |
| 27 | | 1.95 | 2.0 | 2.6 | 2.85 | 2.2 | 1.5 | 1.4 | 1.5 | 1.75 | 1.8 | 1.6 |
| 28 | | 1.95 | 2.0 | 2.7 | 2.8 | 2.0 | 1.45 | 1.4 | 1.5 | 1.75 | 1.8 | 1.6 |
| 29 | | | 2.0 | 2.6 | 2.8 | 2.0 | 1.4 | 1.4 | 1.55 | 1.75 | 1.8 | 1.6 |
| 30 | | | 2.0 | 2.6 | 2.75 | 1.95 | 1.4 | 1.4 | 1.7 | 1.8 | 1.75 | 1.6 |
| 31 | 1.9 | | 1.95 | | 2.75 | | 1.4 | 1.4 | | 1.8 | | 1.6 |

NOTE.—Narrow strip of ice along edges during part of the winter months, but not enough to materially affect the flow.

*Station rating table for Weber River near Croydon, Utah, from January 31 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 50 | 2.10 | 274 | 2.80 | 673 | 3.40 | 1,160 |
| 1.50 | 73 | 2.20 | 319 | 2.90 | 745 | 3.50 | 1,250 |
| 1.60 | 99 | 2.30 | 368 | 3.00 | 820 | 3.60 | 1,345 |
| 1.70 | 128 | 2.40 | 422 | 3.10 | 900 | 3.70 | 1,445 |
| 1.80 | 160 | 2.50 | 480 | 3.20 | 985 | 3.80 | 1,545 |
| 1.90 | 195 | 2.60 | 541 | 3.30 | 1,070 | 3.90 | 1,650 |
| 2.00 | 233 | 2.70 | 605 | | | | |

NOTE.—The above table is applicable only for open channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 1.4 feet and 3.1 feet.

*Estimated monthly discharge of Weber River near Croydon, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February | 214 | 114 | 175 | 9,719 |
| March | 319 | 195 | 246 | 15,130 |
| April | 605 | 214 | 346 | 20,590 |
| May | 782 | 368 | 574 | 35,290 |
| June | 1,650 | 214 | 876 | 52,130 |
| July | 195 | 50 | 119 | 7,317 |
| August | 73 | 50 | 52.2 | 3,210 |
| September | 128 | 50 | 73 | 4,344 |
| October | 160 | 99 | 115 | 7,071 |
| November | 178 | 144 | 157 | 9,342 |
| December | 178 | 73 | 112 | 6,887 |
| The period | | | | 171,000 |

NOTE.—See note to gage-height table, p. 40.

## WEBER RIVER NEAR PLAIN CITY, UTAH.

This station was established in 1903 by the State of Utah, under the direction of the State engineer, and was maintained under his direction until May 14, 1905, when it was taken up by the United States Geological Survey with the stipulation that the expense of daily gage readings should be defrayed by the State. It is located at the Plain City and West Weber highway bridge, about 10 miles west of Ogden, on the main road leading to Plain City and West Weber, below all points of diversion from and inflow to the stream.

The station is important as showing the amount of water discharged by the stream into Great Salt Lake, information necessary to the adjudication of water rights on the Ogden and Weber rivers.

Both banks are abrupt and sufficiently high to prevent overflow. The bed of the stream is composed of clay, sand, and gravel and is comparatively smooth, but it is liable to shift during flood seasons. At normal stages the stream is sluggish, but at high water the velocity ranges from 2 to 3.5 feet per second. The discharge at this point may vary from 5,500 second-feet during the spring flood to almost nothing during summer, when the entire flow is diverted above for irrigation, that passing the station being merely seepage from the irrigated lands tributary to the stream. Information as to ice conditions is as yet indefinite.

Discharge measurements are made from the upstream side of the bridge, which is a two-span steel truss structure, with a center pier of two metallic cylindrical caissons 4 feet in diameter and filled with concrete. The floor railing of the bridge is marked at 5-foot intervals, beginning at a zero mark which is coincident with the north face of the south abutment, this being the initial point for soundings.

The upstream face of the center bridge pier is graduated to feet and tenths, marked with white paint, and forms the gage, which is read daily by David O. Wadman. No bench marks have yet been established.

*Discharge measurements of Weber River near Plain City, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 13 | C. Tanner | 127 | 564 | 2.45 | 8.30 | 1,382 |
| May 18 | W. G. Swendsen | 132 | 789 | 2.40 | 9.30 | 1,894 |
| September 8[a] | A. B. Larson | 19 | 5.1 | .92 | 2.80 | 4.7 |
| November 17 | W. G. Swendsen | 105 | 110 | 1.04 | 4.00 | 115 |

[a] Measurement made 100 feet below station.

*Daily gage height, in feet, of Weber River near Plain City, Utah, for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 1 | | 6.5 | 3.2 | 2.8 | 2.8 | 3.2 | 4.1 | 4.5 |
| 2 | | 6.7 | 3.1 | 2.8 | 2.8 | 3.3 | 4.2 | 4.5 |
| 3 | | 6.7 | 3.0 | 2.8 | 2.8 | 3.3 | 4.2 | 4.5 |
| 4 | | 6.6 | 3.0 | 2.8 | 2.8 | 3.4 | 4.2 | 4.5 |
| 5 | | 6.8 | 3.0 | 2.8 | 2.8 | 3.3 | 4.2 | 4.5 |
| 6 | | 6.6 | 3.0 | 2.8 | 2.8 | 3.2 | 4.2 | 4.5 |
| 7 | | 6.4 | 2.9 | 2.8 | 2.8 | 3.1 | 4.2 | 4.5 |
| 8 | | 6.1 | 2.9 | 2.8 | 2.8 | 3.2 | 4.2 | 4.5 |
| 9 | | 6.8 | 2.9 | 2.8 | 2.8 | 3.2 | 4.2 | 4.6 |
| 10 | | 7.4 | 2.9 | 2.8 | 2.8 | 3.3 | 4.2 | 4.6 |
| 11 | | 6.8 | 2.9 | 2.8 | 2.8 | 3.3 | 4.2 | 4.6 |
| 12 | | 6.6 | 3.0 | 2.8 | 2.8 | 3.2 | 4.2 | 4.7 |
| 13 | 8.3 | 6.4 | 3.0 | 2.8 | 2.8 | 3.1 | 4.2 | 4.7 |
| 14 | 8.3 | 6.2 | 2.9 | 2.8 | 2.8 | 3.1 | 4.1 | 4.7 |
| 15 | 8.2 | 6.0 | 2.8 | 2.8 | 2.8 | 3.1 | 4.1 | 4.7 |
| 16 | 8.3 | 5.9 | 2.8 | 2.8 | 2.8 | 3.2 | 4.1 | 4.7 |
| 17 | 8.6 | 6.0 | 2.8 | 2.8 | 2.9 | 3.2 | 4.1 | 4.8 |
| 18 | 9.1 | 6.1 | 2.8 | 2.8 | 2.9 | 3.2 | 4.1 | 4.8 |
| 19 | 9.8 | 5.9 | 2.8 | 2.8 | 3.2 | 3.3 | 4.1 | 4.9 |
| 20 | 9.8 | 5.6 | 2.8 | 2.8 | 3.2 | 3.3 | 4.1 | 4.9 |
| 21 | 10.1 | 5.0 | 2.8 | 2.8 | 3.2 | 3.4 | 4.1 | 4.9 |
| 22 | 9.8 | 5.0 | 2.8 | 2.8 | 3.1 | 3.4 | 4.2 | 4.9 |
| 23 | 9.4 | 5.1 | 2.8 | 2.8 | 3.1 | 3.5 | 4.2 | 5.0 |
| 24 | 9.0 | 4.9 | 2.8 | 2.8 | 3.1 | 3.5 | 4.3 | 5.0 |
| 25 | 8.4 | 4.5 | 2.8 | 2.8 | 3.2 | 3.6 | 4.4 | 5.0 |
| 26 | 8.0 | 4.3 | 2.8 | 2.8 | 3.2 | 3.7 | 4.5 | 5.0 |
| 27 | 8.0 | 4.0 | 2.8 | 2.8 | 3.2 | 3.7 | 4.5 | 5.0 |
| 28 | 7.9 | 3.4 | 2.8 | 2.8 | 3.2 | 3.8 | 4.5 | 5.1 |
| 29 | 7.9 | 3.0 | 2.8 | 2.8 | 3.2 | 3.9 | 4.5 | 5.1 |
| 30 | 7.4 | 3.0 | 2.8 | 2.8 | 3.2 | 4.0 | 4.5 | 5.1 |
| 31 | 7.0 | ........ | 2.8 | 2.8 | ........ | 4.1 | ........ | 5.1 |

NOTE.—Stream probably frozen after December 17.

*Station rating table for Weber River near Plain City, Utah, from May 13 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.80 | 5 | 4.30 | 158 | 5.80 | 483 | 7.40 | 1,007 |
| 2.90 | 8 | 4.40 | 174 | 5.90 | 511 | 7.60 | 1,088 |
| 3.00 | 13 | 4.50 | 191 | 6.00 | 540 | 7.80 | 1,173 |
| 3.10 | 19 | 4.60 | 209 | 6.10 | 569 | 8.00 | 1,260 |
| 3.20 | 26 | 4.70 | 228 | 6.20 | 599 | 8.20 | 1,348 |
| 3.30 | 34 | 4.80 | 248 | 6.30 | 629 | 8.40 | 1,438 |
| 3.40 | 43 | 4.90 | 269 | 6.40 | 660 | 8.60 | 1,530 |
| 3.50 | 53 | 5.00 | 290 | 6.50 | 691 | 8.80 | 1,624 |
| 3.60 | 64 | 5.10 | 312 | 6.60 | 723 | 9.00 | 1,720 |
| 3.70 | 76 | 5.20 | 334 | 6.70 | 755 | 9.20 | 1,817 |
| 3.80 | 88 | 5.30 | 357 | 6.80 | 788 | 9.40 | 1,916 |
| 3.90 | 101 | 5.40 | 381 | 6.90 | 822 | 9.60 | 2,016 |
| 4.00 | 115 | 5.50 | 405 | 7.00 | 857 | 9.80 | 2,117 |
| 4.10 | 129 | 5.60 | 430 | 7.20 | 930 | 10.00 | 2,220 |
| 4.20 | 143 | 5.70 | 456 | | | | |

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905 and the form of the 1903-4 curve. It is well defined.

*Estimated monthly discharge of Weber River near Plain City, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 13-31 | 2,272 | 857 | 1,544 | 58,190 |
| June | 1,007 | 13 | 501 | 29,810 |
| July | 26 | 5 | 8.3 | 510 |
| August | 5 | 5 | 5.0 | 307 |
| September | 26 | 5 | 12.9 | 768 |
| October | 129 | 19 | 45.4 | 2,792 |
| November | 191 | 129 | 148 | 8,807 |
| December 1-17 | 248 | 191 | 208 | 7,014 |
| The period | | | | 108,100 |

## LOST CREEK NEAR CROYDEN, UTAH.

Lost Creek, which enters Weber River near the town of Croyden, drains an area of 205 square miles. The basin is generally rough and barren, the rocks being conglomerate and sandstone, with a few outcropping ledges of loose, porous limestone and but a thin layer of soil. The stream flows for the most part in a narrow canyon, with occasional small flats devoted to irrigated farms. Near the head the creek receives numerous tributaries, all short and confined to steep, narrow canyons. The normal flow comes principally from springs, well distributed over the entire watershed, but the spring flood is caused by the melting of snow, which forms the greater part of the precipitation. There are no forests, swamps, or meadows along the stream. A few undeveloped storage sites exist in the upper portion of the basin.

The station was established February 3, 1905. It is located about 150 feet above the junction of Lost Creek with Weber River, about 10 miles down Weber River from Echo, and about 1¼ miles west of the town of Croyden on the main road up Lost Creek. The data derived are of value in connection with the amount of water to be diverted into the Henefer reservoir.

The channel is slightly curved for about 100 feet above and 75 feet below the station. The right bank is steep and high; the left bank is sloping and near the channel is sufficiently high to prevent overflow, but about 50 feet back there is an old channel, originally occupied by the stream, which may contain some water during extreme floods. The bed of the creek is composed of gravel and sand and is liable to shift at flood stages. A slight raise in the bed about 20 feet below the gage causes a small riffle. The velocity is moderate and fairly uniform.

Discharge measurements are made by wading. The section is located about 20 feet above the gage and is marked by a 4 by 4 inch by 2-foot stake, the initial point for soundings, driven into the right bank about 6 feet from the edge.

The gage, which is read daily by Isaiah Stewart, a farmer, is an inclined 4 by 4 inch by 12-foot piece of Oregon fir, fastened to vertical posts embedded in the right bank. As the bank is composed of loose gravel and sand the permanency of the gage is uncertain. The bench mark is a 3-inch metallic post, set 3½ feet in the ground at a point 50 feet north east of the gage and 15 feet northwest of the initial stake; elevation above gage datum 8.71 feet.

*Discharge measurements of Lost Creek near Croyden, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 2 | W. G. Swendsen | 30 | 24 | 1.00 | 2.85 | 24 |
| May 2 [a] | do | 27 | 72 | 2.53 | 3.50 | 181 |
| June 28 | do | 26 | 15 | 1.00 | 2.68 | 15 |
| August 19 | W. D. Beers | 20 | 12 | .82 | 2.60 | 10 |

[a] Gaging made at bridge.

*Daily gage height, in feet, of Lost Creek near Croyden, Utah, for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 2.85 | 2.85 | 3.4 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 2 | 2.85 | 2.85 | 2.85 | 3.5 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 3 | 2.85 | 2.85 | 2.85 | 3.45 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 4 | 2.85 | 2.85 | 2.85 | 3.35 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.55 |
| 5 | 2.8 | 2.85 | 2.85 | 3.3 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 6 | 2.8 | 2.85 | 2.85 | 3.3 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 7 | 2.8 | 2.85 | 2.85 | 3.25 | 2.75 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 8 | 2.8 | 2.85 | 2.85 | 3.2 | 2.8 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 9 | 2.8 | 2.85 | 2.9 | 3.25 | 2.8 | 2.65 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 10 | 2.8 | 2.85 | 3.0 | 3.25 | 2.8 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 11 | 2.8 | 2.85 | 2.95 | 3.2 | 2.8 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.65 |
| 12 | 2.7 | 2.85 | 2.95 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 13 | 2.7 | 2.85 | 2.9 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 14 | 2.75 | 2.85 | 2.9 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 15 | 2.75 | 2.85 | 2.9 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 16 | 2.75 | 2.85 | 2.9 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 17 | 2.8 | 2.85 | 3.0 | 3.2 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 18 | 2.8 | 2.85 | 3.0 | 3.25 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 19 | 2.8 | 2.85 | 3.0 | 3.3 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 20 | 2.8 | 2.85 | 3.0 | 3.3 | 2.75 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 21 | 2.8 | 2.85 | 3.1 | 3.3 | 2.7 | 2.6 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 |
| 22 | 2.8 | 2.85 | 3.05 | 3.35 | 2.7 | 2.6 | 2.6 | 2.6 | 2.55 | 2.6 | 2.6 |
| 23 | 2.85 | 2.85 | 3.0 | 3.35 | 2.7 | 2.6 | 2.6 | 2.6 | 2.55 | 2.6 | 2.6 |
| 24 | 2.85 | 2.85 | 3.1 | 3.35 | 2.7 | 2.6 | 2.6 | 2.6 | 2.55 | 2.6 | 2.6 |
| 25 | 2.85 | 2.85 | 3.1 | 3.3 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 26 | 2.85 | 2.85 | 3.15 | 3.2 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 27 | 2.85 | 2.85 | 3.2 | 3.2 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 28 | 2.85 | 2.85 | 3.3 | 2.8 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 29 | ........ | 2.85 | 3.3 | 2.8 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 30 | ........ | 2.85 | 3.3 | 2.8 | 2.7 | 2.6 | 2.6 | 2.55 | 2.55 | 2.6 | 2.6 |
| 31 | ........ | 2.85 | ........ | 2.75 | ........ | 2.6 | 2.6 | ........ | 2.55 | ........ | 2.6 |

NOTE.—Open-channel conditions throughout the year.

## CHALK CREEK AT COALVILLE, UTAH.

Chalk Creek joins Weber River at Coalville. Its basin is rough and barren, the rocks being chiefly sandstone and conglomerate, with but little overlying soil. Small springs scattered over the entire area furnish the principal part of the normal flow, while the spring and flood run-off is derived from melting snow. The stream has few tributaries. There are no swamps, meadows, or forests in the area. Small tracts of irrigated lands lie near the mouth of the canyon. The water supply of the town of Coalville comes mostly from this stream.

The gaging station was established October 23, 1904. It is located at a foot bridge on the main road leading north, one-eighth mile from the county court-house at Coalville.

The channel is slightly curved and somewhat irregular for about 150 feet above the station. Below it is wider and is straight for about 100 feet. Both banks are sufficiently high to prevent overflow. The bed of the stream is composed of small cobbles and is somewhat rough, but apparently permanent. There is but one channel at all stages, broken during high water by the supporting piles of the bridge. The velocity is moderate and the stream shallow.

Discharge measurements are made from the foot bridge. The initial point for soundings is the zero mark near the left end of the bridge.

The gage, which is read daily by Miss Eva Rees, consists of a vertical staff attached to a pile near the right bank of the stream. The bench mark is a cut on the south corner of the stone abutment of the highway bridge; elevation, 0.00 feet above gage datum.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 254–255.

*Discharge measurements of Chalk Creek at Coalville, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 8 | W. G. Swendsen | 34 | 21 | 0.77 | 1.42 | 16 |
| May 1 | do | 44 | 64 | 2.45 | 2.25 | 154 |
| June 16 | do | 32 | 42 | 1.58 | 1.86 | 67 |
| June 27 | do | 38 | 28 | .80 | 1.50 | 22 |

*Daily gage height, in feet, of Chalk Creek at Coalville, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.5 | 1.5 | 1.5 | 2.19 | 2.38 | 1.25 | 1.2 | 1.13 | 1.37 | 1.47 | 1.5 |
| 2 | ...... | 1.5 | 1.55 | 1.63 | 2.18 | 2.38 | 1.25 | 1.2 | 1.13 | 1.32 | 1.46 | 1.5 |
| 3 | 1.5 | ...... | 1.55 | 1.57 | 2.08 | 2.32 | 1.24 | 1.19 | 1.13 | 1.31 | 1.52 | 1.5 |
| 4 | ...... | 1.5 | 1.52 | 1.57 | 2.03 | 2.4 | 1.23 | 1.18 | ...... | 1.42 | 1.6 | 1.46 |
| 5 | ...... | ...... | 1.52 | 1.6 | 1.97 | 2.32 | 1.22 | 1.18 | 1.13 | 1.44 | 1.53 | 1.45 |
| 6 | ...... | 1.5 | ...... | 1.6 | 1.96 | 2.19 | 1.2 | 1.18 | 1.13 | 1.43 | 1.51 | ...... |
| 7 | 1.4 | ...... | 1.52 | 1.62 | 1.98 | 2.2 | 1.2 | 1.19 | 1.15 | 1.45 | 1.53 | ...... |
| 8 | ...... | ...... | 1.42 | ...... | 2.03 | 2.27 | 1.18 | 1.19 | 1.2 | ...... | 1.52 | 1.4 |
| 9 | ...... | ...... | 1.5 | 1.68 | 1.98 | 2.35 | 1.2 | 1.17 | 1.2 | 1.37 | 1.55 | ...... |
| 10 | ...... | 1.5 | 1.5 | 1.8 | 1.93 | 2.25 | 1.23 | 1.2 | ...... | 1.37 | 1.43 | ...... |
| 11 | 1.4 | 1.5 | 1.54 | 1.66 | 1.88 | 2.15 | 1.21 | 1.2 | 1.2 | 1.47 | 1.44 | ...... |
| 12 | ...... | ...... | 1.54 | 1.65 | 1.86 | 2.02 | 1.17 | 1.19 | 1.2 | 1.47 | 1.39 | 1.35 |
| 13 | ...... | ...... | 1.54 | 1.69 | 1.87 | 2.03 | 1.2 | 1.17 | 1.18 | 1.45 | 1.43 | ...... |
| 14 | 1.4 | 1.5 | 1.56 | 1.71 | 1.87 | 2.02 | 1.28 | 1.18 | 1.19 | ...... | 1.53 | ...... |
| 15 | ...... | ...... | 1.54 | 1.67 | 1.91 | 1.99 | ...... | 1.2 | 1.2 | ...... | 1.43 | 1.37 |
| 16 | ...... | ...... | 1.56 | 1.73 | 2.02 | 1.95 | 1.21 | 1.17 | 1.2 | 1.45 | 1.37 | 1.4 |
| 17 | ...... | 1.5 | 1.55 | 1.76 | 2.17 | 1.92 | 1.33 | 1.17 | ...... | ...... | 1.55 | ...... |
| 18 | 1.51 | ...... | 1.58 | 1.73 | 2.4 | 1.91 | 1.35 | 1.15 | 1.2 | 1.55 | 1.5 | ...... |
| 19 | 1.52 | ...... | 1.62 | 1.82 | 2.4 | 1.81 | 1.4 | 1.15 | 1.2 | 1.57 | 1.35 | 1.38 |
| 20 | ...... | 1.5 | 1.6 | 1.83 | 2.6 | 1.8 | 1.57 | 1.15 | 1.2 | 1.55 | 1.5 | ...... |
| 21 | 1.52 | ...... | 1.57 | 1.81 | 2.55 | 1.68 | 1.54 | 1.15 | 1.2 | 1.55 | 1.5 | 1.38 |
| 22 | ...... | ...... | 1.5 | 1.8 | 2.47 | 1.67 | 1.52 | 1.15 | 1.2 | 1.57 | 1.5 | ...... |
| 23 | ...... | 1.5 | 1.62 | 1.8 | 2.47 | 1.67 | 1.53 | 1.15 | 1.2 | 1.56 | 1.43 | ...... |
| 24 | ...... | 1.5 | 1.6 | 1.82 | 2.4 | 1.67 | ...... | 1.15 | 1.2 | 1.53 | 1.43 | ...... |
| 25 | 1.5 | 1.5 | 1.52 | 1.9 | 2.3 | 1.62 | 1.5 | 1.15 | 1.2 | ...... | 1.36 | ...... |
| 26 | ...... | 1.5 | 1.56 | 1.98 | 2.3 | 1.55 | ...... | 1.15 | 1.22 | 1.55 | 1.33 | ...... |
| 27 | ...... | 1.5 | 1.55 | 2.05 | 2.3 | 1.55 | 1.2 | 1.15 | 1.2 | 1.55 | ...... | ...... |
| 28 | 1.5 | ...... | 1.5 | 2.1 | 2.37 | 1.46 | 1.23 | 1.15 | ...... | 1.55 | ...... | 1.4 |
| 29 | ...... | ...... | 1.53 | 2.1 | 2.25 | 1.36 | 1.21 | 1.15 | 1.3 | 1.55 | ...... | ...... |
| 30 | 1.5 | ...... | 1.6 | 2.11 | 2.2 | 1.28 | 1.17 | ...... | 1.4 | 1.56 | 1.3 | 1. |
| 31 | 1.5 | ...... | 1.6 | ...... | 2.3 | ...... | 1.19 | 1.13 | ...... | 1.58 | ...... | ...... |

NOTE.—Ice conditions January 1 to February 22 and December 6–31.

*Station rating table for Chalk Creek at Coalville, Utah, from October 23, 1904, to December 31 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 3 | 1.50 | 22 | 1.90 | 74 | 2.30 | 168 |
| 1.20 | 6 | 1.60 | 31 | 2.00 | 94 | 2.40 | 197 |
| 1.30 | 10 | 1.70 | 43 | 2.10 | 116 | 2.50 | 227 |
| 1.40 | 15 | 1.80 | 57 | 2.20 | 141 | 2.60 | 258 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1904-5. It is well defined between gage heights 1.4 feet and 2.25 feet.

*Estimated monthly discharge of Chalk Creek at Coalville, Utah, for 1904 and 1905.*

[Drainage area, 248 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| 1904. | | | | | | |
| October 23-31 | 22 | 20 | 21.6 | 386 | 0.087 | 0.029 |
| November | 31 | 8 | 20.2 | 1,202 | .081 | .090 |
| 1905. | | | | | | |
| February 23-28 | 22 | 22 | 22.0 | 262 | .089 | .020 |
| March | 33 | 16 | 26.0 | 1,599 | .105 | .121 |
| April | 118 | 22 | 55.4 | 3,296 | .223 | .249 |
| May | 274 | 68 | 139 | 8,547 | .560 | .646 |
| June | 197 | 9 | 95.2 | 5,665 | .384 | .428 |
| July | 28 | 4.8 | 11.0 | 676 | .044 | .051 |
| August | 6 | 3.6 | 4.8 | 295 | .019 | .022 |
| September | 15 | 3.6 | 5.9 | 351 | .024 | .027 |
| October | 29 | 10 | 20.9 | 1,285 | .084 | .097 |
| November | 31 | 10 | 18.7 | 1,113 | .075 | .084 |
| December 1-5 | 22 | 18 | 20.6 | 204 | .083 | .015 |
| The period (1905) | | | | 23,290 | | |

NOTE.—Ice conditions December, 1904, January 1 to February 22, and December 6-31, 1905. Discharge interpolated on days when gage was not read.

## AMERICAN FORK BASIN.

### AMERICAN FORK NEAR AMERICAN FORK, UTAH.

American Fork drains a rough, broken, limestone country, comprising a portion of the western slopes of the Wasatch Mountains. The stream is confined to a steep, narrow canyon, and receives few tributaries, its normal flow being derived almost entirely from springs. There are no storage reservoirs, swamps, or lakes in the area, and the timber growth is scanty. The entire summer flow is diverted for irrigation near the mouth of the canyon; the winter flow and a part of the spring flood is discharged into Utah Lake.

The station was established May 21, 1900. It is located about 6 miles northeast of the town of American Fork, Utah, 50 feet north of the county road, and 200 feet southwest of the electric power house.

Measurements are made over a sharp-crested rectangular weir. A nail driven into the weir structure just south of the south opening, and level with the crest of the weir, serves to determine gage heights, which are read daily by Peter Anderson. During floods considerable gravel is deposited in the weir approach, making measurements at such times erroneous; this condition is partly overcome by raising the crest and sluicing out the deposit.

Information in regard to this station is contained in the following publication, of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, p 469; WS 51, p 417-418; 66, p 124; 100, p 139; 133, p 259.
Discharge. WS 51, p 418; 66, p 124; 100, p 140.
Discharge, daily mean. WS 133, p 260.
Discharge, monthly: Ann 13, iii, p 96, 20, iv, p 469; WS 75, p 195; 133, pp 260-261.
Discharge, yearly. Ann 13, iii, p 99, 20, iv, p 61.
Gage heights. WS 51, p 419; 66, p 124; 100, p 140; 133, p 259.
Rating table: WS 66, p 176; 12, ii, p 361.

*Daily gage height, in feet, of American Fork near American Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.39 | 0.38 | 0.40 | 0.38 | 0.90 | 1.36 | 0.90 | 0.48 | 0.36 | 0.43 | 0.37 | 0.33 |
| 2 | .40 | .39 | .40 | .38 | .84 | 1.34 | .85 | .48 | .36 | .42 | .37 | .34 |
| 3 | .39 | .38 | .41 | .38 | .76 | 1.45 | .85 | .47 | ....... | .41 | .37 | ....... |
| 4 | .40 | .37 | .41 | .38 | .73 | 1.39 | .79 | .47 | .38 | .41 | .37 | .31 |
| 5 | .41 | ....... | .41 | .41 | .69 | 1.39 | .79 | .47 | .39 | .40 | .37 | .31 |
| 6 | .39 | .37 | .42 | .43 | .66 | 1.39 | .77 | .46 | .40 | .39 | .37 | .29 |
| 7 | .39 | .38 | .44 | .52 | .66 | 1.41 | .75 | .46 | .39 | .39 | .37 | .29 |
| 8 | .37 | .37 | .43 | .52 | .68 | 1.57 | .78 | .46 | .38 | .40 | .37 | .31 |
| 9 | .38 | .37 | .43 | ....... | .69 | 1.45 | .77 | .45 | .37 | .39 | .36 | .31 |
| 10 | .38 | .38 | .43 | .58 | .68 | 1.35 | .74 | .44 | .36 | .39 | .36 | .31 |
| 11 | .37 | .38 | .43 | .52 | .60 | 1.35 | .75 | .44 | .36 | .39 | .36 | .31 |
| 12 | .38 | .23 | .44 | .50 | .60 | 1.41 | .73 | .43 | .35 | .38 | .36 | .31 |
| 13 | .38 | .33 | .44 | .49 | .62 | 1.50 | .72 | .41 | .35 | .38 | .36 | .31 |
| 14 | .38 | .37 | .44 | .50 | .63 | 1.50 | .71 | .41 | .35 | .38 | .36 | .31 |
| 15 | .38 | .37 | .44 | .51 | .64 | 1.47 | .68 | .40 | .35 | .38 | .36 | .31 |
| 16 | .38 | .37 | .44 | .53 | .76 | 1.37 | .65 | .40 | .35 | .38 | .35 | .31 |
| 17 | .38 | .37 | .43 | .53 | .97 | 1.34 | .65 | .40 | .35 | .37 | .35 | .31 |
| 18 | .38 | .37 | .43 | .53 | 1.01 | 1.14 | .62 | .40 | .35 | .36 | .35 | .31 |
| 19 | .37 | .37 | .43 | .56 | 1.11 | 1.08 | .60 | .39 | .35 | .36 | .35 | .31 |
| 20 | .37 | .37 | .43 | .55 | 1.16 | 1.14 | .56 | .38 | .35 | .36 | .36 | .31 |
| 21 | .38 | .37 | .42 | .55 | 1.19 | 1.17 | .56 | .38 | .37 | .38 | .36 | .30 |
| 22 | .38 | .37 | .43 | .54 | 1.16 | 1.27 | .55 | .38 | .37 | .38 | .36 | .30 |
| 23 | .38 | .37 | .43 | .56 | 1.16 | 1.24 | .53 | .38 | .37 | .38 | .36 | .30 |
| 24 | .37 | .37 | .44 | .59 | 1.16 | 1.12 | .52 | .41 | .37 | .38 | .35 | .31 |
| 25 | .37 | .38 | .43 | .62 | 1.28 | 1.10 | .51 | .39 | .38 | .38 | .35 | .30 |
| 26 | .37 | .39 | .45 | .71 | 1.26 | 1.05 | .49 | .37 | .37 | .38 | .35 | .32 |
| 27 | .37 | .39 | .45 | .72 | 1.27 | 1.01 | .49 | .38 | .37 | .38 | .33 | .30 |
| 28 | .37 | .40 | .45 | .74 | 1.16 | .96 | .49 | .38 | .47 | .38 | .30 | .32 |
| 29 | .37 | ....... | .45 | .75 | 1.11 | .94 | .48 | .41 | .52 | .38 | .30 | .32 |
| 30 | .37 | ....... | .43 | .86 | 1.10 | .92 | .48 | .38 | .45 | .38 | .32 | .30 |
| 31 | .37 | ....... | .43 | ....... | 1.32 | ....... | .49 | .38 | ....... | .38 | ....... | .32 |

NOTE.—January 1 to March 29 and September 28 to December 31, crest 30.5 feet long; March 30 and 31, crest 33 feet long; April 1 to September 27, crest 36.5 feet long. Ice conditions on the river affect the flow at the weir but little.

*Daily discharge, in second-feet, of American Fork near American Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 24 | 26 | 28 | 104 | 193 | 104 | 40 | 26 | 29 | 23 | 19 |
| 2 | 26 | 25 | 26 | 28 | 94 | 189 | 95 | 40 | 26 | 28 | 23 | 20 |
| 3 | 25 | 24 | 27 | 28 | 81 | 212 | 95 | 39 | [a] 27 | 27 | 23 | [a] 19 |
| 4 | 26 | 23 | 27 | 28 | 76 | 199 | 85 | 39 | 28 | 27 | 23 | 18 |
| 5 | 27 | [a] 23 | 27 | 32 | 70 | 199 | 85 | 39 | 30 | 26 | 23 | 18 |
| 6 | 25 | 23 | 28 | 35 | 65 | 199 | 82 | 38 | 31 | 25 | 23 | 16 |
| 7 | 25 | 24 | 30 | 46 | 65 | 203 | 79 | 38 | 30 | 25 | 23 | 16 |
| 8 | 23 | 23 | 29 | 46 | 68 | 239 | 84 | 38 | 28 | 26 | 23 | 18 |
| 9 | 24 | 23 | 29 | [a] 50 | 70 | 212 | 82 | 37 | 27 | 25 | 22 | 18 |
| 10 | 24 | 24 | 29 | 54 | 68 | 191 | 77 | 35 | 26 | 25 | 22 | 18 |
| 11 | 23 | 24 | 29 | 46 | 56 | 191 | 79 | 35 | 26 | 25 | 22 | 18 |
| 12 | 24 | 11 | 30 | 43 | 56 | 203 | 76 | 34 | 25 | 24 | 22 | 18 |
| 13 | 24 | 19 | 30 | 42 | 59 | 223 | 74 | 32 | 25 | 24 | 22 | 18 |
| 14 | 24 | 23 | 30 | 43 | 61 | 223 | 73 | 32 | 25 | 24 | 22 | 18 |
| 15 | 24 | 23 | 30 | 44 | 62 | 217 | 68 | 31 | 25 | 24 | 22 | 18 |
| 16 | 24 | 23 | 30 | 47 | 81 | 195 | 64 | 31 | 25 | 24 | 21 | 18 |
| 17 | 24 | 23 | 29 | 47 | 116 | 189 | 64 | 31 | 25 | 23 | 21 | 18 |
| 18 | 24 | 23 | 29 | 47 | 123 | 148 | 59 | 31 | 25 | 22 | 21 | 18 |
| 19 | 23 | 23 | 29 | 51 | 142 | 136 | 56 | 30 | 25 | 22 | 21 | 18 |
| 20 | 23 | 23 | 29 | 50 | 152 | 148 | 51 | 28 | 25 | 22 | 22 | 18 |
| 21 | 24 | 23 | 28 | 50 | 158 | 154 | 51 | 28 | 27 | 24 | 22 | 17 |
| 22 | 24 | 23 | 29 | 48 | 152 | 174 | 50 | 28 | 27 | 24 | 22 | 17 |
| 23 | 24 | 23 | 29 | 51 | 152 | 168 | 47 | 28 | 27 | 24 | 22 | 17 |
| 24 | 23 | 23 | 30 | 55 | 152 | 144 | 46 | 32 | 27 | 24 | 21 | 18 |
| 25 | 23 | 24 | 29 | 59 | 176 | 140 | 44 | 30 | 28 | 24 | 21 | 17 |
| 26 | 23 | 25 | 31 | 73 | 172 | 131 | 42 | 27 | 27 | 24 | 21 | 18 |
| 27 | 23 | 25 | 31 | 74 | 174 | 123 | 42 | 28 | 27 | 24 | 19 | 17 |
| 28 | 23 | 26 | 31 | 77 | 152 | 114 | 42 | 28 | 33 | 24 | 17 | 18 |
| 29 | 23 | ....... | 31 | 79 | 142 | 111 | 40 | 32 | 38 | 24 | 17 | 18 |
| 30 | 23 | ....... | 31 | 97 | 140 | 107 | 40 | 28 | 31 | 24 | 18 | 17 |
| 31 | 23 | ....... | 31 | ....... | 184 | ....... | 42 | 28 | ....... | 24 | ....... | 18 |

[a] Discharge interpolated.

*Estimated monthly discharge of American Fork near American Fork, Utah, for 1905.*

[Drainage area, 66 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 27 | 23 | 24.0 | 1,476 | 0.364 | 0.420 |
| February | 26 | 11 | 23.0 | 1,277 | .348 | .362 |
| March | 31 | 26 | 29.2 | 1,795 | .442 | .510 |
| April | 97 | 28 | 49.9 | 2,969 | .756 | .844 |
| May | 184 | 56 | 110 | 6,763 | 1.67 | 1.92 |
| June | 239 | 107 | 176 | 10,470 | 2.67 | 2.98 |
| July | 104 | 40 | 65.1 | 4,003 | .986 | 1.14 |
| August | 40 | 27 | 32.7 | 2,011 | .495 | .571 |
| September | 38 | 25 | 27.4 | 1,630 | .415 | .463 |
| October | 29 | 22 | 24.5 | 1,506 | .371 | .428 |
| November | 23 | 17 | 21.5 | 1,279 | .326 | .364 |
| December | 20 | 16 | 17.8 | 1,094 | .270 | .311 |
| The year | 239 | 11 | 50.1 | 36,270 | .759 | 10.31 |

## PROVO RIVER BASIN.

### DESCRIPTION OF BASIN.

Provo River has its source in the Uinta Mountains and flows westward in a steep, narrow canyon until it reaches Heber or Provo Valley, through which it winds in a well-defined channel. Leaving the valley, it flows southwestward, cutting through the Wasatch Range in another steep, narrow, and extremely rough canyon, and finally discharging its surplus waters into Utah Lake.

In the mountain regions the principal rock is a compact limestone. Except in Heber Valley there is but little soil in any portion of the basin. Small groves of fir and aspen are, however, scattered over almost the entire area, and there is a light growth of underbrush. There are no extensive forests, meadows, or marshes. In the canyons the stream receives numerous short and swift tributaries, deriving their principal supply from springs, but a part also from the melting of the snow, which covers portions of the high mountains during the entire year. The highest peaks reach elevations of about 13,000 feet.

Heber Valley, which comprises an area of about 20 square miles, is an irrigated farming district, composed of a deposit of loose bowlders, gravel, and soil, very porous. Most of the water comes from the main stream, though a part is received from small creeks which enter the valley from the south. The most important of these is Daniels Creek, into which some water is diverted from Strawberry River, a tributary of Green River, by three small canals in low passes at the head of the creek.

There are a few lakes at the head of the river, but they are so small that they probably have little effect in regulating the flow. There is no storage on the stream at present, but a few possibilities exist which will doubtless be developed in the future, as the entire stream, after being used at the mouth of the canyon for the development of power, is now utilized on lands in the vicinity of Utah Lake, and the supply is altogether insufficient.

### PROVO RIVER ABOVE TELLURIDE POWER COMPANY'S DAM, NEAR PROVO, UTAH.

This station was established March 1, 1905. It is located about three-fourths of a mile up the river from Upper Falls, a station on the Provo Canyon branch of the Rio Grande Western Railway, about 4 miles above the mouth of the canyon and 800 feet south of the canyon road, in J. W. Slick's pasture. It is about one-half mile above the Telluride Power Company's dam and above all diversions into Utah Lake Valley. The object of the station is the collection of data concerning the amount of water passing from the river into this valley.

The channel has a slight uniform curvature for about 200 feet above and 300 feet below the station, describing approximately the arc of a circle. Both banks are sufficiently high to prevent overflow; the left bank is formed by the Rio Grande Western Railway grade. The bed of the stream is composed of well-compacted rock and soil, is comparatively smooth, and is not liable to shift, but a slight growth of moss occurs from the time of the spring flood until freezing weather. The velocity is low near the right bank, but increases uniformly to a point near the left. The discharge may vary from 100 to 1,400 second-feet. Conditions of free flow exist except for a very short distance near the left bank.

Discharge measurements are made by means of a cable and car. The cable is marked at 4-foot intervals, beginning at the north support, which is the initial point for soundings.

Daily gage readings are made, without expense to the Geological Survey, by the Telluride Power Company, the observations being under the direction of E. A. Briscoe, an engineer at the power house about 4 miles below the station. The gage is of the inclined type and consists of a 4-by-4 inch by 16-foot fir, bolted to a vertical cedar post embedded in the bank at the water's edge and to a box-elder stump at the shore end, about 25 feet upstream from the cable on the left bank. It is graduated with saw cuts and paint to read vertically. The gage is referred to bench marks as follows: (1) A 4-inch iron pipe with a metallic cap, set 3½ feet in the ground at a point 12 feet from the north cable post, under a fence; this has an elevation of 7.31 feet above gage datum and is so stamped on the top. (2) A projecting point, marked with black paint, on a limestone ledge in a railroad cut about a foot above the track and 22 feet upstream from the line of the gage; elevation, 17.18 feet above datum of gage.

*Discharge measurements of Provo River above Telluride Power Company's dam, near Provo, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 28[a] | H. S. Kleinschmidt | 70 | 144 | 1.51 | 3.73 | 217 |
| March 3[b] | W. G. Swendsen | 69 | 130 | 2.26 | 3.93 | 294 |
| May 13 | do | 71 | 132 | 2.35 | 4.05 | 309 |
| June 14 | Hoyt & Swendsen | 75 | 223 | 3.68 | 5.30 | 820 |
| June 22 | do | 71 | 166 | 2.82 | 4.43 | 469 |
| August 28[c] | A. B. Larson | 67 | 94 | 1.46 | 3.62 | 136 |
| September 27[c] | W. G. Swendsen | 67 | 85 | 1.64 | 3.57 | 139 |

[a] Measurement by wading 35 feet above cable.
[b] Measurement by wading approximately at present cable station.
[c] Growing moss changed conditions.

*Daily gage height, in feet, of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.85 | 3.9 | 3.85 | 4.4 | 5.15 | 4.0 | 3.9 | 3.7 | 3.65 | 3.75 | 3.9 |
| 2 | 4.1 | 4.0 | 3.85 | 4.4 | 5.4 | 3.95 | 3.85 | 3.6 | 3.65 | 3.75 | 3.9 |
| 3 | 3.9 | 4.0 | 3.85 | 4.5 | 5.5 | 3.95 | 3.9 | 3.6 | 3.65 | 3.75 | 3.9 |
| 4 | 3.9 | 4.1 | 3.85 | 4.4 | 5.6 | 3.95 | 3.8 | 3.6 | 3.65 | 3.75 | 3.9 |
| 5 | 3.9 | 4.05 | 3.8 | 4.2 | 5.77 | 3.95 | 3.8 | 3.6 | 3.65 | 3.75 | 3.85 |
| 6 | 3.85 | 4.05 | 3.85 | 4.1 | 5.5 | 3.95 | 3.8 | 3.6 | 3.65 | 3.75 | 3.65 |
| 7 | 3.85 | 4.0 | 3.85 | 4.1 | 5.4 | 3.95 | 3.8 | 3.6 | 3.65 | 3.75 | 3.6 |
| 8 | 3.85 | 3.95 | 3.85 | 4.1 | 5.8 | 3.95 | 3.8 | 3.6 | 3.55 | 3.8 | 3.55 |
| 9 | 3.8 | 3.9 | 3.85 | 4.25 | 6.1 | 3.95 | 3.8 | 3.6 | 3.65 | 3.8 | 3.55 |
| 10 | 3.8 | 3.9 | 3.95 | 4.2 | 5.9 | 3.95 | 3.8 | 3.6 | 3.6 | 4.0 | 3.6 |
| 11 | 3.8 | 3.9 | 4.1 | 4.2 | 5.4 | 3.95 | 3.85 | 3.6 | 3.6 | 4.0 | 3.6 |
| 12 | 5.8 | 3.9 | 4.0 | 4.1 | 5.15 | 3.95 | 3.85 | 3.6 | 3.6 | 3.8 | 3.6 |
| 13 | 5.1 | 3.9 | 4.0 | 4.1 | 5.15 | 3.95 | 3.8 | 3.6 | 3.6 | 3.85 | 3.6 |
| 14 | 5.1 | 3.9 | 4.0 | 4.1 | 5.2 | 3.95 | 3.75 | 3.6 | 3.6 | 3.85 | 3.6 |
| 15 | 4.7 | 3.9 | 4.0 | 4.1 | 5.1 | 4.0 | 3.75 | 3.6 | 3.6 | 3.85 | 3.8 |
| 16 | 4.1 | 3.9 | 4.1 | 4.0 | 5.05 | 3.95 | 3.8 | 3.6 | 3.6 | 3.85 | 3.8 |
| 17 | 3.8 | 3.85 | 4.1 | 4.1 | 4.9 | 3.95 | 3.8 | 3.6 | 3.6 | 3.85 | 3.8 |
| 18 | 3.8 | 3.85 | 4.1 | 4.25 | 4.8 | 3.95 | 3.7 | 3.6 | 3.6 | 3.9 | 3.8 |
| 19 | 3.8 | 3.85 | 4.1 | 4.4 | 4.6 | 3.9 | 3.8 | 3.6 | 3.6 | 3.9 | 3.8 |
| 20 | 3.8 | 3.9 | 4.1 | 4.45 | 4.45 | 3.9 | 3.7 | 3.6 | 3.6 | 3.9 | 3.8 |
| 21 | 3.8 | 3.9 | 4.15 | 4.6 | 4.4 | 3.9 | 3.7 | 3.6 | 3.6 | 3.9 | 3.7 |
| 22 | 3.8 | 4.0 | 4.1 | 4.7 | 4.45 | 3.9 | 3.7 | 3.55 | 3.6 | 3.9 | 3.7 |
| 23 | 3.8 | 3.95 | 4.1 | 4.8 | 4.4 | 3.9 | 3.7 | 3.55 | 3.65 | 3.9 | 3.7 |
| 24 | 3.8 | 3.9 | 4.1 | 4.85 | 4.35 | 3.9 | 3.7 | 3.55 | 3.65 | 3.85 | 3.8 |
| 25 | 3.8 | 3.9 | 4.1 | 4.8 | 4.35 | 3.9 | 3.7 | 3.6 | 3.65 | 3.85 | 3.8 |
| 26 | 3.8 | 3.85 | 4.3 | 4.8 | 4.4 | 3.85 | 3.7 | 3.6 | 3.65 | 3.85 | 3.8 |
| 27 | 3.85 | 4.0 | 4.3 | 4.9 | 4.1 | 3.85 | 3.65 | 3.6 | 3.65 | 3.85 | 3.8 |
| 28 | 3.9 | 3.9 | 4.3 | 5.0 | 4.05 | 3.85 | 3.7 | 3.55 | 3.65 | 3.9 | 3.8 |
| 29 | ........ | 3.9 | 4.3 | 5.1 | 4.0 | 3.85 | 3.65 | 3.7 | 3.7 | 3.9 | 3.8 |
| 30 | ........ | 3.95 | 4.5 | 4.9 | 4.0 | 3.85 | 3.7 | 3.7 | 3.7 | 3.9 | 3.8 |
| 31 | ........ | 3.9 | ........ | 4.85 | ........ | 3.9 | 3.7 | ........ | 3.75 | ........ | 3.8 |

**NOTE.**—Ice jam February 12, 13, and 14. Open-channel conditions during the remainder of the winter months.

*Daily discharge, in second-feet, of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 254 | 269 | 254 | 446 | 763 | 301 | 245 | 163 | 159 | 193 | 244 |
| 2 | 335 | 301 | 254 | 446 | 879 | 285 | 237 | 135 | 159 | 194 | 245 |
| 3 | 269 | 301 | 254 | 485 | 926 | 285 | 243 | 136 | 160 | 194 | 245 |
| 4 | 269 | 335 | 254 | 446 | 973 | 285 | 212 | 136 | 160 | 194 | 245 |
| 5 | 269 | 318 | 238 | 371 | 1,054 | 284 | 211 | 137 | 160 | 194 | 230 |
| 6 | 254 | 318 | 254 | 335 | 926 | 284 | 210 | 137 | 160 | 194 | 170 |
| 7 | 254 | 301 | 254 | 335 | 879 | 283 | 209 | 138 | 160 | 194 | 156 |
| 8 | 254 | 285 | 254 | 335 | 1,069 | 282 | 208 | 138 | 132 | 210 | 143 |
| 9 | 238 | 269 | 254 | 389 | 1,215 | 281 | 207 | 139 | 161 | 210 | 143 |
| 10 | 238 | 269 | 285 | 371 | 1,117 | 280 | 206 | 139 | 147 | 273 | 157 |
| 11 | 238 | 269 | 335 | 371 | 879 | 280 | 221 | 140 | 147 | 273 | 157 |
| 12 | 238 | 269 | 301 | 335 | 763 | 279 | 220 | 140 | 147 | 210 | 157 |
| 13 | 238 | 269 | 301 | 335 | 763 | 278 | 203 | 141 | 147 | 226 | 157 |
| 14 | 238 | 269 | 301 | 335 | 786 | 277 | 187 | 141 | 147 | 227 | 158 |
| 15 | 238 | 269 | 301 | 335 | 740 | 292 | 187 | 142 | 148 | 227 | 216 |
| 16 | 238 | 269 | 335 | 301 | 717 | 275 | 200 | 142 | 148 | 227 | 216 |
| 17 | 238 | 254 | 335 | 335 | 651 | 274 | 200 | 143 | 148 | 227 | 216 |
| 18 | 238 | 254 | 335 | 389 | 608 | 273 | 168 | 143 | 148 | 242 | 216 |
| 19 | 238 | 254 | 335 | 446 | 525 | 256 | 197 | 144 | 148 | 242 | 216 |
| 20 | 238 | 269 | 335 | 466 | 466 | 255 | 167 | 144 | 148 | 243 | 216 |
| 21 | 238 | 269 | 353 | 525 | 446 | 255 | 166 | 145 | 149 | 243 | 187 |
| 22 | 238 | 301 | 335 | 566 | 466 | 254 | 165 | 132 | 149 | 243 | 187 |
| 23 | 238 | 285 | 335 | 608 | 446 | 254 | 164 | 133 | 163 | 243 | 187 |
| 24 | 238 | 269 | 335 | 630 | 427 | 253 | 163 | 133 | 163 | 228 | 217 |
| 25 | 238 | 269 | 335 | 608 | 427 | 253 | 162 | 147 | 163 | 228 | 217 |
| 26 | 238 | 254 | 408 | 608 | 446 | 236 | 161 | 147 | 163 | 229 | 218 |
| 27 | 254 | 301 | 408 | 651 | 335 | 236 | 144 | 147 | 164 | 229 | 218 |
| 28 | 269 | 269 | 408 | 695 | 318 | 237 | 158 | 132 | 164 | 244 | 218 |
| 29 | ........ | 269 | 408 | 740 | 301 | 237 | 146 | 173 | 178 | 244 | 218 |
| 30 | ........ | 285 | 485 | 651 | 301 | 238 | 162 | 173 | 178 | 244 | 218 |
| 31 | ........ | 209 | ........ | 630 | ........ | 245 | 162 | ........ | 193 | ........ | 218 |

NOTE.—Discharge February 12-16 assumed as 238 second-feet, on account of ice conditions. A rating table was used to obtain daily discharge February 1 to July 4. The daily discharge July 5 to December 31 was obtained by indirect methods, as applied to shifting channels. The effect produced by the existence of moss at this station seems to be about the same as by a shifting of the bed, i. e., the moss seems to collect sediment and make a soft coating over the bed of the stream, but does not affect flow near surface.

*Estimated monthly discharge of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February | 335 | 238 | 249 | 13,830 |
| March | 335 | 254 | 279 | 17,160 |
| April | 485 | 238 | 319 | 18,980 |
| May | 740 | 301 | 468 | 28,780 |
| June | 1,215 | 301 | 687 | 40,880 |
| July | 301 | 236 | 267 | 16,420 |
| August | 245 | 144 | 190 | 11,680 |
| September | 173 | 132 | 143 | 8,509 |
| October | 193 | 132 | 157 | 9,654 |
| November | 273 | 193 | 226 | 13,450 |
| December | 245 | 143 | 200 | 12,300 |
| The period | | | | 191,600 |

## PROVO RIVER AT MOUTH OF CANYON, NEAR PROVO, UTAH.

This station was established July 27, 1889. It is located about 6 miles north of Provo, about 1,000 feet above Olmstead station, on the Provo Canyon branch of the Rio Grande Western Railway, and 1,200 feet above the power house of the Telluride Power Company.

The station was originally established to determine the total flow of the Provo above all diversions to Utah Lake Valley; but since that time a small canal has been taken out about 3 miles above the station and the system of the Telluride Power Company has been extended by a new flume line of sufficient capacity to divert the entire normal flow of the stream. The power plant of the Telluride Power Company has been rebuilt at a point about 1,200 feet below the station, the tailrace discharging directly into the canals at the mouth of the canyon. Practically no water now passes the station except the flood discharge and a small portion of the side drainage between the power company's dam and the gaging station, the greater part of the side drainage being diverted into the flume at various points along the line. The station is thus of little importance, but it is maintained at an extremely low cost, since the gage readings are made by the Telluride Power Company and the discharge curve is so well defined that but few more measurements are necessary.

The channel is straight for about 200 feet above and 100 feet below the station. The right bank is steep and rocky and does not overflow; the left is somewhat low and sloping and is liable to overflow at extreme flood stages. The bed of the stream is composed of bowlders and soil and is very rough, but permanent. The velocity is high, ranging from 4 to 6 feet per second. Ice forms near the banks and appears also as drift or floating ice. It is, however, limited in quantity and probably never piles up or gorges. There is no anchor or needle ice at any time.

Discharge measurements are made by means of a cable and car. The cable is marked at 3-foot intervals with white paint. The initial point for soundings is the first white mark on the cable south of the vertical post that supports the cable on the right bank. A guy line is stretched across the stream about 40 feet above the station and is found useful at all stages.

The original gage was of the inclined type and consisted of a piece of Oregon fir attached to vertical posts embedded in the left bank about 2 feet below the line of the cable. The present gage, daily readings of which are made under the direction of E. A. Brisco, an engineer at the power plant, is a vertical piece of aspen driven into the stream bed and supported at the top by a horizontal piece buried in the bank. It is located on the right bank about 30 feet above the line of the cable. Simultaneous readings on the two gages are found to be equal, but the zero of the new gage is 0.10 foot above that of the old one. The bench marks are as follows: (1) A cross chiseled in a limestone rock about 1 foot square, 100 feet S. 15° E. from the old gage; elevation above old gage datum, 6.98 feet. (2) A standard United States Geological Survey metallic plug, cemented in the top of the south abutment of the highway bridge about one-eighth mile below the station; elevation above zero of gage, 4.75 feet. (3) A cross chiseled on the top of a bowlder projecting 1 foot above the ground, 126 feet N. 75° W. from the north post supporting the cable; elevation above zero of gage, 11.21 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description**: Ann 14, ii, p 123; 18, iv, pp 325–326; Bull 131, p 59; 140, p 234; WS 16, p 162; 28, p 146; 38, pp 338–339; 51, p 416; 66, p 123; 85, p 88; 100, pp 140–141, 142–143; 133, pp 261–262.

**Discharge**: Ann 18, iv, p 326; Bull 131, p 92; 140, p 234; WS 16, p 162; 28, p 153; 38, p 339; 51, p 416; 100, p 141; 66, p 123; 85, p 88; 100, p 143; 133, p 262.

**Discharge, monthly**: Ann 11, ii, p 104; 12, ii, pp 354, 361; 13, iii, p 97; 14, ii, pp 123–124; 18, iv, p 327; 19, iv, p 442; 20, iv, pp 458, 468; 21, iv, p 399; 22, iv, p 416; Bull 140, p 235; WS 75, p 195; 100, pp 142, 144; 133, p 264.

**Discharge, yearly**: Ann 13, iii, p 99; 20, iv, p 61.

**Gage heights**: Bull 131, p 60; 140, p 234; WS 11, p 79; 16, p 162; 28, p 152; 38, p 339; 51, p 417; 66, p 124; 100, p 141, 143–144; 133, p 263.

Hydrographs: Ann 12, ii, p 340; 14, ii, p 125; 18, iv, p 328; 19, iv, p 442; 20, iv, p 468; 21, iv, p 399; 22, iv, p 417.

Rainfall and run-off relation: Ann 20, iv, p 459.

Rating tables: Ann 18, iv, p 326; 19, iv, p 441; Bull 131, p 59; 140, p 234; WS 28, p 154; 39, p 456; 52, p 521; 66, p 176; 100, pp 142, 144; 133, p 263.

Water powers: Ann 19, iv, p 441.

*Discharge measurements of Provo River at mouth of canyon, near Provo, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 4 | Henry Kleinschmidt | 73 | 116 | 2.58 | 4.50 | 309 |
| May 24 | W. G. Swendsen | 75 | 138 | 3.52 | 4.95 | 485 |
| August 29[a] | A. B. Larson | 32 | 41 | .62 | 3.55 | 25 |

[a] Measurement made 100 feet above regular station.

*Daily gage height, in feet, of Provo River at mouth of canyon, near Provo, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.1 | 4.21 | 4.51 | 4.4 | 4.78 | 5.39 | 4.05 | 3.65 | 3.58 | 3.66 | 3.51 | 3.81 |
| 2 | 3.98 | 4.42 | 4.56 | 4.34 | 4.8 | 5.63 | 3.93 | 3.54 | 3.5 | 3.75 | 3.56 | 3.81 |
| 3 | 4.12 | 4.6 | 4.58 | 4.37 | 4.77 | 5.7 | 3.87 | 3.69 | 3.44 | 3.76 | 3.59 | 3.68 |
| 4 | 4.3 | 4.52 | 4.65 | 4.32 | 4.72 | 5.95 | 3.95 | 3.52 | 3.57 | 3.68 | 3.52 | 3.8 |
| 5 | 4.22 | 4.51 | 4.46 | 4.3 | 4.5 | 5.87 | 3.83 | 3.61 | 3.67 | 3.68 | 3.56 | 3.62 |
| 6 | 4.14 | 4.52 | 4.66 | 4.3 | 4.34 | 5.77 | 4.0 | 3.55 | 3.7 | 3.71 | 3.56 | 3.77 |
| 7 | 4.2 | 4.21 | 4.18 | 4.35 | 4.22 | 5.65 | 3.95 | 3.53 | 3.6 | 3.71 | 3.52 | 3.8 |
| 8 | 4.4 | 4.28 | 4.0 | 4.34 | 4.4 | 5.86 | 3.93 | 3.56 | 3.58 | 3.66 | 3.55 | 3.68 |
| 9 | 4.1 | 4.11 | 3.98 | 4.24 | 4.47 | 6.33 | 3.83 | 3.5 | 3.63 | 3.69 | 3.55 | 3.49 |
| 10 | 4.1 | 4.14 | 3.91 | 4.6 | 4.5 | 5.97 | 3.65 | 3.51 | 3.64 | 3.7 | 4.04 | 3.45 |
| 11 | 4.1 | 4.08 | 3.88 | 4.68 | 4.49 | 5.65 | 3.63 | 3.55 | 3.48 | 3.61 | 3.92 | 3.45 |
| 12 | 4.38 | 4.08 | 4.2 | 4.35 | 4.28 | 5.19 | 3.6 | 3.55 | ...... | 3.63 | 4.05 | 3.48 |
| 13 | 4.1 | 4.01 | 4.14 | 4.25 | 4.3 | 5.75 | 3.6 | 3.53 | ...... | 3.6 | 4.03 | 3.51 |
| 14 | 4.12 | 4.0 | 4.0 | 4.4 | 4.28 | 5.75 | 3.7 | 3.49 | ...... | 3.62 | 3.96 | 3.47 |
| 15 | 4.05 | 4.05 | 4.3 | 4.44 | 4.29 | 5.53 | 3.67 | 3.52 | ...... | 3.64 | 3.98 | 3.68 |
| 16 | 4.07 | 4.09 | 4.52 | 4.45 | 4.4 | 5.5 | 3.63 | 3.57 | ...... | 3.63 | 4.0 | 3.6 |
| 17 | 3.79 | 4.2 | 4.5 | 4.52 | 4.45 | 5.23 | 3.6 | 3.5 | ...... | 3.59 | 3.99 | 3.62 |
| 18 | 3.78 | 4.1 | 4.4 | 4.52 | 4.43 | 5.0 | 3.63 | 3.45 | ...... | 3.64 | 3.89 | 3.62 |
| 19 | 4.02 | 4.12 | 4.5 | 4.51 | 4.76 | 4.87 | 3.65 | 3.63 | ...... | 3.65 | 3.91 | ...... |
| 20 | 4.1 | 4.15 | 4.57 | 4.51 | 4.77 | 4.78 | 3.62 | 3.61 | ...... | 3.58 | 3.76 | ...... |
| 21 | 3.56 | 4.14 | 4.18 | 4.56 | 4.89 | 4.71 | 3.5 | 3.53 | ...... | 3.61 | 3.89 | ...... |
| 22 | 4.04 | 4.11 | 4.45 | 4.5 | 5.06 | 4.77 | 3.5 | 3.46 | ...... | 3.63 | 3.82 | ...... |
| 23 | 4.14 | 4.15 | 4.43 | ...... | 5.1 | 4.85 | 3.5 | 3.55 | ...... | 3.57 | 3.88 | ...... |
| 24 | 4.13 | 4.25 | 4.49 | 4.4 | 5.09 | 4.7 | 3.55 | 3.68 | ...... | 3.57 | 3.8 | ...... |
| 25 | 4.05 | 4.22 | 4.43 | 4.45 | 5.0 | 4.43 | 3.6 | 3.59 | 3.51 | 3.55 | 3.74 | ...... |
| 26 | 4.08 | 4.21 | 4.43 | 4.75 | 5.02 | 4.17 | 3.6 | 3.59 | 3.52 | 3.6 | 3.93 | ...... |
| 27 | 4.06 | 4.42 | 4.49 | 4.94 | 5.1 | 4.2 | 3.58 | 3.56 | 3.49 | 3.61 | 3.9 | ...... |
| 28 | 4.03 | 4.5 | 4.48 | 4.84 | 5.2 | 4.15 | 3.57 | 3.57 | 3.55 | 3.59 | 3.95 | ...... |
| 29 | 4.03 | ...... | 4.43 | 4.72 | 5.22 | 4.05 | 3.6 | ...... | 3.85 | 3.58 | 3.95 | ...... |
| 30 | 4.08 | ...... | 4.43 | 4.78 | 5.15 | 3.93 | 3.6 | ...... | 3.78 | 3.65 | 3.91 | ...... |
| 31 | 4.13 | ...... | 4.34 | ...... | 5.1 | ...... | ...... | ...... | ...... | 3.64 | ...... | ...... |

*Station rating table for Provo River at mouth of canyon, near Provo, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 12 | 4.20 | 177 | 5.00 | 532 | 5.80 | 1,050 |
| 3.50 | 20 | 4.30 | 212 | 5.10 | 589 | 5.90 | 1,120 |
| 3.60 | 31 | 4.40 | 250 | 5.20 | 649 | 6.00 | 1,192 |
| 3.70 | 46 | 4.50 | 290 | 5.30 | 711 | 6.10 | 1,265 |
| 3.80 | 64 | 4.60 | 332 | 5.40 | 775 | 6.20 | 1,340 |
| 3.90 | 87 | 4.70 | 377 | 5.50 | 841 | 6.30 | 1,415 |
| 4.00 | 114 | 4.80 | 425 | 5.60 | 910 | 6.40 | 1,490 |
| 4.10 | 144 | 4.90 | 477 | 5.70 | 980 | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined between gage heights 3.5 feet and 6.3 feet.

*Daily discharge, in second-feet, of Telluride Power Company's flume near Provo, Utah, for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 24 | 52 | 40 | 40 | 45 | 79 | 163 | 130 | 136 | 173 |
| 2 | 29 | 40 | 62 | 35 | 62 | 88 | 141 | 130 | 124 | 184 |
| 3 | 23 | 41 | 78 | 40 | 70 | 85 | 117 | 130 | 125 | 170 |
| 4 | 29 | 38 | 77 | 29 | 68 | 82 | 126 | 145 | 124 | 178 |
| 5 | 36 | 36 | 49 | 24 | 75 | 74 | 148 | 150 | 127 | 183 |
| 6 | 41 | 36 | 57 | 59 | 61 | 106 | 131 | 130 | 130 | 175 |
| 7 | 43 | 34 | 66 | 41 | 62 | 80 | 139 | 127 | 130 | 163 |
| 8 | 33 | 45 | 68 | 24 | 59 | 75 | 142 | 130 | 127 | 155 |
| 9 | 37 | 55 | 63 | 70 | 75 | 80 | 137 | 135 | 129 | 167 |
| 10 | 44 | 50 | 49 | 39 | 96 | 69 | 137 | 127 | 162 | 169 |
| 11 | 46 | 26 | 59 | 32 | 95 | 52 | 133 | 130 | 170 | 170 |
| 12 | 27 | 78 | 65 | 39 | 99 | 87 | 136 | 130 | 160 | 150 |
| 13 | 38 | 60 | 66 | 53 | 101 | 80 | ........ | ........ | 160 | 171 |
| 14 | 25 | 51 | 62 | 48 | 90 | 88 | ........ | ........ | 155 | 168 |
| 15 | 43 | 55 | 54 | 50 | 98 | 85 | ........ | 130 | 153 | 188 |
| 16 | 49 | 55 | 43 | 42 | 97 | 85 | ........ | 131 | 160 | 185 |
| 17 | 41 | 48 | 59 | 58 | 100 | 79 | ........ | 128 | 160 | 183 |
| 18 | 56 | 36 | 70 | 48 | 94 | 89 | ........ | 126 | 160 | 187 |
| 19 | 62 | 83 | 45 | 42 | 92 | 105 | ........ | 129 | 161 | ........ |
| 20 | 41 | 66 | 55 | 48 | 85 | 124 | ........ | 135 | ........ | ........ |
| 21 | 56 | 60 | 38 | 45 | 87 | 130 | ........ | 126 | ........ | ........ |
| 22 | 62 | 65 | 40 | 41 | 87 | 131 | ........ | 158 | ........ | ........ |
| 23 | 49 | ........ | 50 | 42 | 87 | 117 | ........ | 150 | ........ | ........ |
| 24 | 47 | 85 | 44 | 37 | 84 | 123 | ........ | 158 | ........ | ........ |
| 25 | 38 | 75 | 48 | 68 | 81 | 114 | 133 | 161 | ........ | ........ |
| 26 | 40 | ........ | 36 | 81 | 80 | 150 | 124 | 141 | ........ | ........ |
| 27 | 39 | ........ | 65 | 45 | 80 | 146 | 122 | 135 | ........ | ........ |
| 28 | 32 | 50 | 48 | 47 | 80 | 121 | 119 | 142 | ........ | ........ |
| 29 | 44 | 37 | 32 | 40 | 77 | ........ | 157 | ........ | ........ | ........ |
| 30 | 53 | 33 | 44 | 64 | 78 | ........ | 137 | ........ | ........ | ........ |
| 31 | 54 | ........ | 30 | ........ | ........ | ........ | ........ | 160 | ........ | ........ |

*Estimated monthly discharge of Provo River at mouth of canyon, near Provo, Utah, for 1905.*

[Drainage area, 640 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 250 | 27 | 142 | 8,731 | 0.222 | 0.256 |
| February | 332 | 114 | 190 | 10,550 | .297 | .309 |
| March | 359 | 82 | 239 | 14,700 | .373 | .430 |
| April | 499 | 191 | 288 | 17,140 | .450 | .502 |
| May | 661 | 184 | 396 | 24,350 | .619 | .714 |
| June | 1,438 | 95 | 687 | 40,880 | 1.07 | 1.19 |
| July | 129 | 20 | 50.1 | 3,080 | .078 | .090 |
| August | 44 | 16 | 26.8 | 1,648 | .042 | .048 |
| September (17 days) | 76 | 15 | 32.6 | 1,099 | .051 | .032 |
| October | 56 | 26 | 37.1 | 2,281 | .058 | .067 |
| November | 129 | 21 | 73.0 | 4,344 | .114 | .127 |
| December 1-18 | 66 | 16 | 38.3 | 1,368 | .060 | .040 |
| The period | | | | 130,200 | | |

*Estimated monthly discharge of Telluride Power Company's flume near Provo, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 62 | 23 | 41.3 | 2,539 |
| April (27 days) | 85 | 26 | 51.5 | 2,758 |
| May | 78 | 30 | 53.6 | 3,296 |
| June | 81 | 24 | 45.7 | 2,719 |
| July 1-30 | 101 | 45 | 81.5 | 4,850 |
| August 1-28 | 150 | 52 | 97.3 | 5,404 |
| September 1-12,25-30 | 163 | 117 | 136 | 4,856 |
| October (27 days) | 161 | 126 | 137 | 7,337 |
| November 1-19 | 170 | 124 | 140 | 5,276 |
| December 1-18 | 188 | 150 | 173 | 6,176 |
| The period | | | | 45,210 |

NOTE.—To obtain total flow of Provo River at head of diversion dams, the flume discharge should be added to that of the gaging station given above.

## PROVO RIVER AT THE RIO GRANDE WESTERN RAILWAY BRIGDE, NEAR PROVO, UTAH.

This station was established January 25, 1905. It is located at the Rio Grande Western Railway bridge about 2 miles northwest of the town of Provo, below all points of diversion and inflowing streams. It replaces the old station maintained at the San Pedro Los Angeles, and Salt Lake Railroad bridge, about 300 feet below, the conditions at the latter point being so changed by the reconstruction of the bridge that the section could no longer be used.

The purpose of the station is to determine the amount of water discharged by the Provo into Utah Lake. As the entire normal spring and summer flow is diverted for irrigation above this point, the station is maintained only during flood and winter seasons.

The channel is straight for about 150 feet above and 200 feet below the station. The normal flow is confined to a comparatively narrow channel near the center, but the high-water channel is much wider, including a small timbered flat on both sides. The railroad grade, however, prevents any overflow at the gaging section. The bed of the stream is composed of coarse gravel and is liable to change during floods. The velocity is uniform but high, ranging from 4 to 7 feet. Information in regard to ice conditions is incomplete.

Discharge measurements are made from a foot plank, fastened to 4 by 4 inch pieces of fir bolted to the lower chord on the upstream side of the bridge. The plank is graduated with paint, beginning at the north face of the masonry abutment on the south end of the bridge, which is the initial point for soundings. A guy line is stretched 24 feet upstream from the foot plank.

The gage, which is read daily by Lars Thompson, a farmer, is of the inclined type, consisting of a 4 by 4 inch by 16-foot timber of Oregon fir drift-bolted to the old piles and sills of the former bridge, about 10 feet east of the present bridge, the incline being such that 15.88 feet along the piece equal 10 feet vertical. It is graduated with saw cuts and paint to read vertically. The gage is referred to bench marks as follows: (1) A standard United States Geological Survey metallic plug, cemented in the masonry wall, 0.5 foot south of its face at the southeast corner of the bridge; this is 11.29 feet above the gage datum and is so stamped. (2) A cross cut in the top of the same wall at the southwest corner of the bridge; elevation above gage datum, 11.25 feet.

*Discharge measurements of Provo River at the Rio Grande Western Railway bridge, near Provo, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 25 | H. S. Kleinschmidt | 44 | 54 | 3.52 | 2.80 | 191 |
| February 14[a] | do | 37 | 38 | 3.12 | 2.53 | 120 |
| February 16 | do | 43 | 49 | 3.49 | 2.74 | 170 |
| March 9 | do | 43 | 49 | 3.36 | 2.70 | 166 |
| June 21 | W. G. Swendsen | 17 | 8.5 | 1.52 | 2.00 | 12.9 |

[a] Ice divides stream into two channels.

*Daily gage height, in feet, of Provo River at the Rio Grande Western Railway Bridge, near Provo, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | Day. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.85 | 2.75 | 2.6 | 2.7 | 2.55 | 17 | | 2.75 | 2.65 | 2.75 | 2.0 | 3.05 |
| 2 | | 3.1 | 2.75 | 2.55 | 2.8 | 3.05 | 18 | | 2.7 | 2.65 | 2.7 | 2.0 | 2.8 |
| 3 | | 3.15 | 2.8 | 2.52 | 2.8 | 3.5 | 19 | | 2.7 | 2.7 | 2.6 | 2.0 | 2.47 |
| 4 | | 3.0 | 2.9 | 2.53 | 2.7 | 3.7 | 20 | | 2.7 | 2.85 | 2.7 | 2.25 | 2.18 |
| 5 | | 2.95 | 3.0 | 2.5 | 2.6 | 3.75 | 21 | | 2.7 | 2.75 | 2.75 | 2.1 | 2.0 |
| 6 | | 2.9 | 3.0 | 2.5 | 2.4 | 3.6 | 22 | | 2.7 | 2.75 | 2.9 | 2.15 | Dry. |
| 7 | | 2.85 | 2.9 | 2.47 | 2.25 | 3.54 | 23 | | 2.7 | 2.7 | 2.9 | 2.6 | |
| 8 | | 2.8 | 2.8 | 2.45 | 2.2 | 3.65 | 24 | | 2.7 | 2.65 | 2.9 | 2.62 | |
| 9 | | 2.85 | 2.7 | 2.6 | 2.2 | 4.27 | 25 | | 2.7 | 2.65 | 2.85 | 2.58 | |
| 10 | | 2.85 | 2.7 | 2.75 | 2.4 | 4.2 | 26 | 2.8 | 2.68 | 2.65 | 2.75 | 2.62 | |
| 11 | | 2.85 | 2.7 | 2.85 | 2.3 | 3.73 | 27 | 2.8 | 2.65 | 2.8 | 2.85 | 2.68 | |
| 12 | | 2.8 | 2.7 | 2.8 | 2.15 | 3.55 | 28 | 2.8 | 2.65 | 2.7 | 2.9 | 2.75 | |
| 13 | | 2.6 | 2.67 | 2.8 | 2.05 | 3.53 | 29 | 2.8 | | 2.65 | 2.75 | 2.8 | |
| 14 | | 2.55 | 2.7 | 2.75 | 2.1 | 3.45 | 30 | 2.8 | | 2.7 | 2.7 | 2.65 | |
| 15 | | 2.7 | 2.7 | 2.7 | 2.0 | 3.43 | 31 | 2.8 | | 2.65 | | 2.55 | |
| 16 | | 2.8 | 2.65 | 2.7 | 2.25 | 3.25 | | | | | | | |

NOTE.—Station discontinued June 22.

## HOBBLE CREEK BASIN.

### HOBBLE CREEK NEAR SPRINGVILLE, UTAH.

Hobble Creek rises on the western slope of the Wasatch Mountains and flows in a general southwesterly direction to Utah Lake. There is little overlying soil and but a scanty growth of timber or brush. The steep, narrow canyon in which the stream flows is broken here and there by narrow openings or flats, covered with a shallow deposit of bowlders and soil and comprising irrigated farms. As these tracts lie along the banks of the creek, a large part of the water used on them is returned to the stream as seepage. There are no tributaries of importance, but short, intermittent streams, each of which is confined to a steep, narrow canyon, enter all along the course. There are no storage reservoirs, lakes, or marshes to control the flood discharge, which occurs in the spring as the result of melting snow. The entire normal summer flow is used for irrigation, but the diversion takes place for the most part at the mouth of the canyon below the gaging station.

The station was established March 23, 1904. It is located about 1 mile above the mouth of the canyon, 4 miles southeast of Springville, Utah, 600 feet northeast of the head of Mapleton Canal, and about 1,200 feet southwest of the Springville electric power plant.

The channel is straight for about 75 feet above and 50 feet below the station. Both banks are high and wooded. The bed of the stream is of loose, fine gravel, and shifts almost constantly. There is but one channel at all stages. The velocity ranges from 3 to 4.5 feet per second. As the normal winter flow comes largely from springs, the stream probably does not freeze at the station.

Discharge measurements are made by wading at a point near the gage. The initial point for soundings is a 2 by 4 inch post located on the south bank near the water's edge.

The gage, which is read daily by J. B. Stevenson, an electrician, is a vertical staff, driven into the bed of the stream and fastened at the top to an overhanging tree. The gage is referred to bench marks as follows: (1) A nail in the top of the 2 by 4 inch post used as the initial point for soundings; elevation above gage datum, 4.91 feet. (2) A nail in a post set 26 feet south of the initial point; elevation above gage datum, 12.38 feet. (3) A 30-penny nail in the east side of a pole of the electric transmission line, 97 feet northwest of the initial point; elevation, 21.80 feet above gage datum.

A description of this station, gage height and discharge data, and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pages 268–270.

*Discharge measurements of Hobble Creek near Springville, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 16 | H. S. Kleinschmidt | 14 | 12 | 1.62 | 1.25 | 20 |
| April 5 | W. G. Swendsen | 18 | 11 | 2.57 | 1.42 | 28 |
| May 5 | W. P. Hardesty | 18 | 18 | 3.22 | 1.80 | 58 |
| May 23 | W. G. Swendsen | 19 | 29 | 3.92 | 2.30 | 112 |
| June 6 | A. B. Larson | 18 | 17 | 3.84 | 1.75 | 64 |
| June 11 | do | 18 | 21 | 3.72 | 1.80 | 76 |
| June 26 | do | 18 | 16 | 2.82 | 1.55 | 44 |
| July 11 | G. M. P. Dougall | 18 | 9.2 | 2.35 | 1.30 | 22 |
| July 17 | do | 18 | 9.8 | 2.30 | 1.30 | 23 |
| July 29 | G. S. Schow | 18 | 8.7 | 2.21 | 1.16 | 19 |
| August 9 | do | 18 | 9.5 | 2.15 | 1.25 | 20 |
| August 16 | do | 17 | 9.6 | 1.84 | 1.24 | 17.7 |
| August 30 | A. B. Larson | 17 | 9.7 | 1.48 | 1.21 | 14.4 |
| September 16 | G. S. Schow | 17 | 8.7 | 1.65 | 1.20 | 14.5 |
| September 28 | A. B. Larson | 17 | 8.3 | 1.60 | 1.19 | 13.0 |
| October 12 | W. D. Beers | 16 | 7.8 | 1.61 | 1.20 | 12.6 |

*Daily gage height, in feet, of Hobble Creek near Springville, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 1.38 | 1.35 | 1.4 | 2.1 | 1.75 | 1.35 | 1.15 | 1.25 | 1.2 | 1.23 | 1.25 |
| 2 | ....... | 1.4 | 1.35 | ....... | 2.05 | 1.8 | 1.35 | 1.2 | 1.25 | 1.2 | 1.25 | 1.22 |
| 3 | ....... | 1.4 | 1.35 | 1.4 | 1.95 | ....... | 1.3 | 1.3 | 1.25 | 1.18 | 1.22 | 1.2 |
| 4 | ....... | 1.4 | 1.35 | ....... | 1.85 | 1.8 | 1.35 | 1.35 | 1.2 | 1.15 | 1.25 | 1.2 |
| 5 | 1.3 | 1.4 | 1.4 | ....... | 1.8 | 1.85 | 1.3 | ....... | 1.2 | 1.12 | 1.25 | 1.2 |
| 6 | ....... | 1.4 | 1.4 | 1.45 | 1.75 | 1.8 | 1.26 | 1.2 | 1.2 | 1.12 | 1.22 | 1.18 |
| 7 | ....... | 1.38 | 1.4 | ....... | 1.7 | 1.8 | 1.24 | 1.25 | 1.25 | 1.1 | 1.23 | 1.2 |
| 8 | ....... | 1.38 | 1.4 | 1.5 | 1.75 | 2.0 | 1.25 | 1.2 | 1.3 | 1.1 | 1.25 | 1.2 |
| 9 | ....... | 1.38 | 1.4 | 1.5 | 1.75 | 1.92 | 1.25 | ....... | 1.3 | 1.12 | 1.28 | 1.2 |
| 10 | ....... | 1.38 | ....... | 1.8 | 1.75 | 1.8 | 1.25 | 1.22 | 1.25 | 1.13 | 1.3 | 1.1 |
| 11 | ....... | ....... | 1.4 | 1.6 | 1.8 | 1.75 | 1.25 | 1.2 | 1.25 | 1.15 | 1.27 | 1.17 |
| 12 | ....... | ....... | ....... | 1.6 | 1.8 | 1.75 | 1.25 | 1.2 | 1.25 | 1.17 | ....... | 1.15 |
| 13 | 1.3 | ....... | 1.4 | 1.6 | 1.9 | 1.75 | 1.25 | 1.15 | 1.25 | 1.2 | 1.2 | 1.15 |
| 14 | ....... | ....... | 1.4 | ....... | 1.95 | 1.85 | 1.25 | 1.2 | 1.25 | 1.18 | 1.22 | 1.18 |
| 15 | ....... | 1.38 | 1.4 | 1.6 | 2.05 | 1.8 | 1.3 | 1.25 | 1.25 | 1.17 | 1.23 | 1.2 |
| 16 | ....... | 1.35 | 1.4 | 1.7 | 2.1 | 1.7 | 1.3 | 1.2 | 1.25 | 1.2 | 1.22 | 1.25 |
| 17 | 1.3 | ....... | 1.4 | 1.6 | 2.3 | 1.6 | 1.3 | 1.2 | 1.25 | 1.2 | 1.23 | 1.22 |
| 18 | ....... | 1.35 | 1.4 | ....... | 2.35 | 1.6 | 1.3 | 1.14 | 1.25 | 1.2 | 1.2 | 1.25 |
| 19 | 1.3 | ....... | 1.4 | 1.7 | 2.4 | 1.65 | 1.3 | 1.12 | 1.22 | 1.18 | 1.18 | 1.25 |
| 20 | ....... | 1.35 | 1.45 | ....... | 2.35 | 1.6 | 1.25 | 1.2 | 1.2 | 1.17 | 1.2 | 1.23 |
| 21 | ....... | 1.35 | 1.4 | 1.62 | 2.4 | 1.53 | 1.3 | 1.15 | 1.2 | 1.2 | 1.2 | 1.22 |
| 22 | ....... | 1.35 | 1.4 | 1.65 | 2.45 | 1.5 | 1.3 | 1.12 | 1.25 | 1.2 | 1.25 | ...... |
| 23 | 1.35 | 1.35 | 1.4 | 1.7 | 2.4 | 1.55 | 1.25 | 1.16 | 1.2 | 1.2 | 1.22 | ...... |
| 24 | ....... | 1.35 | 1.4 | 1.7 | 2.25 | 1.5 | 1.2 | 2.06 | 1.2 | 1.2 | 1.23 | ...... |
| 25 | 1.35 | 1.35 | 1.35 | 1.7 | 2.2 | 1.5 | 1.8 | 1.25 | 1.2 | 1.2 | 1.2 | 1.15 |
| 26 | ....... | 1.35 | 1.35 | 1.85 | 2.1 | 1.55 | 1.2 | 1.27 | 1.2 | 1.18 | 1.2 | 1.15 |
| 27 | 1.33 | 1.35 | 1.45 | 1.95 | 2.0 | 1.5 | 1.2 | 1.25 | 1.2 | 1.18 | 1.25 | 1.25 |
| 28 | ....... | 1.35 | 1.4 | 2.0 | 1.9 | 1.45 | 1.15 | 1.25 | 1.2 | 1.17 | 1.25 | 1.22 |
| 29 | ....... | ....... | 1.4 | 2.0 | 1.7 | 1.42 | 1.15 | 1.3 | 1.35 | 1.2 | 1.25 | ...... |
| 30 | 1.33 | ....... | 1.4 | ....... | 1.7 | 1.4 | 1.15 | 1.2 | 1.2 | 1.2 | 1.25 | 1.23 |
| 31 | 1.35 | ....... | 1.35 | ....... | 1.7 | ....... | 1.2 | 1.2 | ....... | 1.22 | ....... | ...... |

*Station rating table for Hobble Creek near Springville, Utah, from January 1, to May 30, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 22.0 | 1.60 | 40.5 | 1.90 | 68 | 2.20 | 100 |
| 1.40 | 27.5 | 1.70 | 48.5 | 2.00 | 78 | 2.30 | 112 |
| 1.50 | 33.5 | 1.80 | 58 | 2.10 | 89 | 2.40 | 125 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is fairly well defined.

*Station rating table for Hobble Creek near Springville, Utah, from May 31, to December 31, 1905.*

| Gage height. | Discharge | Gage height | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 7.0 | 1.40 | 30.5 | 1.70 | 61 | 2.00 | 99 |
| 1.20 | 14.5 | 1.50 | 40 | 1.80 | 73 | 2.10 | 113 |
| 1.30 | 22.0 | 1.60 | 50 | 1.90 | 86 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 1.8 feet.

*Estimated monthly discharge of Hobble Creek near Springville, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 24 | 22 | 22.8 | 1,402 |
| February | 28 | 24 | 25.6 | 1,422 |
| March | 30 | 24 | 27.0 | 1,660 |
| April | 78 | 28 | 45.2 | 2,690 |
| May | 132 | 48 | 81.0 | 4,980 |
| June | 99 | 30 | 59.4 | 3,534 |
| July | 26 | 11 | 18.6 | 1,144 |
| August | 107 | 8 | 18.3 | 1,125 |
| September | 26 | 14 | 17.1 | 1,018 |
| October | 16 | 7 | 12.5 | 769 |
| November | 22 | 13 | 16.9 | 1,006 |
| December | 18 | 7 | 14.6 | 898 |
| The year | 132 | 7 | 29.9 | 21,650 |

NOTE.—Open-channel conditions assumed throughout the year. Discharge interpolated for missing gage heights.

## SPANISH FORK BASIN.

### SPANISH FORK NEAR SPANISH FORK, UTAH.

Spanish fork rises in the Wasatch Mountains and flows northwestward into Utah Lake. The area is generally barren, with but little timber or brush. The stream is confined to a steep, narrow canyon, with a very few small openings in which are irrigated farms. The tributaries are all short and many of them are intermittent. The most important are Diamond Fork and Thistle Creek, which enter about 8 and 10 miles, respectively, above the gaging station, and which, like the main stream, occupy steep narrow canyons. The normal flow comes largely from springs, scattered over the entire basin; the flood discharge is direct surface run-off from melting snow.

There are no storage reservoirs on the stream and but little of the flow is diverted above the station. The entire normal flow is, however, diverted at the mouth of the canyon, immediately below the station, and used for the irrigation of lands near Utah Lake.

The station was established May 23, 1900, and reestablished March 26, 1903. It is located 600 feet above the dam of the East Bench Irrigation Company, 5 miles southeast of Spanish Fork, and 300 feet southwest of the main line of the Rio Grande Western Railway.

Records at this station are of importance in connection with the Strawberry Valley storage reservoir project, under a plan to divert water from that basin into Spanish Fork near its head and carry it to distribution canals below.

The channel is straight for about 150 feet above and below the station. Both banks slope gradually, are covered with small brush, and are sufficiently high to prevent overflow. The bed is composed of loose gravel and sand, and is smooth but somewhat shifting, especially at flood stages. The velocity is high. There is a free flow, the current being uninterrupted by dams or other obstructions.

Discharge measurements are made by means of a cable and car. The cable is graduated with paint, beginning at the right cable post, which is the initial point for soundings.

The gage, which is read daily by Levi Thorp, a section foreman on the Rio Grande Western Railway, consisted originally of a vertical staff located on the right bank of the stream. In April, 1905, it was replaced by a new 6 by 6 inch inclined gage having the same datum. The bench mark is on a limestone rock 29 feet S. 36° E. from the gage, marked with black paint "U. S. G. S."; elevation above gage datum, 7.16 feet; elevation above mean sea level, 4,785 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann.=Annual Report; WS=Water-Supply Paper):

Description: WS 100, p 145; 133, p 271.
Discharge: WS 100, p 145; 133, p 271.
Discharge, monthly: Ann 13, iii, p 97; WS 100, p 147; 133, p 273.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 61.
Gage heights: WS 100, p 146; 133, p 272.
Rating table: WS 100, pp 146–147; 133, pp 272–273.

*Discharge measurements of Spanish Fork near Spanish Fork, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 27 | H. S. Kleinschmidt | 37 | 30 | 2.68 | 1.42 | 79 |
| February 15 | do | 35 | 28 | 2.66 | 1.38 | 74 |
| March 10 | do | 37 | 29 | 2.51 | 1.40 | 72 |
| April 19 | W. G. Swendsen | 39 | 39 | 3.17 | 1.70 | 111 |
| May 11 | W. P. Hardesty | 36 | 44 | 3.50 | 1.90 | 154 |
| May 15 | W. G. Swendsen | 37 | 49 | 4.04 | 2.00 | 200 |
| May 22 | do | 40 | 85 | 4.34 | 2.82 | 369 |
| May 22 | do | 40 | 85 | 4.42 | 2.82 | 376 |
| May 22 | do | 40 | 85 | 4.00 | 2.82 | 360 |
| June 3 | A. B. Larson | 38 | 68 | 4.59 | 2.45 | 314 |
| June 9 | do | 37 | 49 | 3.99 | 2.04 | 195 |
| June 26 | do | 35 | 30 | 2.85 | 1.60 | 86 |
| July 31 | Beers and Schow | 34 | 25 | 2.19 | 1.40 | 54 |
| August 9 | G. S. Schow | 40 | 21 | 1.99 | 1.32 | 43 |
| August 30 | A. B. Larson | 34 | 20 | 2.60 | 1.41 | 52 |
| September 7 | G. S. Schow | 35 | 25 | 2.56 | 1.47 | 64 |
| September 10 | do | 34 | 20 | 2.39 | 1.38 | 49 |
| September 28 | A. B. Larson | 34 | 22 | 2.35 | 1.41 | 52 |
| October 12 | W. D. Beers | 33 | 24 | 2.46 | 1.48 | 59 |

*Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.46 | 1.6 | 1.5 | 2.06 | 2.56 | 1.52 | 1.36 | 1.36 | 1.64 | 1.48 | 1.46 |
| 2 | 1.26 | 1.56 | 1.56 | 1.48 | 2.04 | 2.52 | 1.5 | 1.34 | 1.36 | 1.56 | 1.48 | 1.44 |
| 3 | 1.5 | 1.5 | 1.62 | 1.48 | 2.02 | 2.48 | 1.5 | 1.4 | 1.36 | 1.44 | 1.48 | 1.4 |
| 4 | 1.32 | 1.5 | 1.54 | 1.46 | 1.96 | 2.38 | 1.46 | 1.36 | 1.61 | 1.44 | 1.48 | 1.44 |
| 5 | 1.4 | 1.5 | 1.5 | 1.48 | 1.92 | 2.26 | 1.44 | 1.36 | 1.42 | 1.42 | 1.48 | 1.5 |
| 6 | 1.56 | 4.48 | 1.5 | 1.48 | 1.82 | 2.24 | 1.46 | 1.36 | 1.4 | 1.44 | 1.48 | 1.4 |
| 7 | 1.4 | 1.46 | 1.48 | 1.5 | 1.82 | 2.14 | 1.46 | 1.3 | 1.44 | 1.45 | 1.48 | 1.44 |
| 8 | 1.4 | 1.46 | 1.48 | 1.52 | 1.84 | 2.1 | 1.46 | 1.3 | 1.42 | 1.42 | 1.48 | 1.44 |
| 9 | 1.4 | 1.4 | 1.46 | 1.54 | 1.98 | 2.02 | 1.4 | 1.3 | 1.4 | 1 42 | 1.48 | 1.44 |
| 10 | 1.42 | 1.42 | 1.46 | 1.76 | 1.96 | 2.02 | 1.42 | 1.36 | 1.4 | 1.48 | 1.48 | 1.4 |
| 11 | 1.44 | 1.44 | 1.46 | 1.7 | 1.9 | 2.0 | 1.42 | 1.5 | 1.4 | 1.48 | 1.48 | 1.3 |
| 12 | 1.4 | 1.26 | 1.44 | 1.7 | 1.84 | 1.96 | 1.4 | 1.4 | 1.4 | 1.48 | 1.48 | 1.24 |
| 13 | 1.38 | 1.6 | 1.46 | 1.66 | 2.0 | 1.88 | 1.38 | 1.38 | 1.4 | 1.46 | 1.4 | 1.25 |
| 14 | 1.42 | 1.4 | 1.48 | 1.64 | 2.0 | 1.82 | 1.4 | 1.38 | 1.4 | 1.46 | 1.44 | 1.4 |
| 15 | 1.42 | 1.4 | 1.48 | 1.62 | 2.0 | 1.76 | 1.4 | 1.36 | 1.4 | 1.48 | 1.44 | 1.3 |
| 16 | 1.44 | 1.34 | 1.44 | 1.7 | 2.04 | 1.76 | 1.4 | 1.34 | 1.4 | 1.48 | 1.44 | 1.25 |
| 17 | 1.42 | 1.44 | 1.46 | 1.7 | 2.22 | 1.74 | 1.4 | 1.34 | 1.34 | 1.48 | 1.46 | 1.3 |
| 18 | 1.42 | 1.42 | 1.46 | 1.66 | 2.41 | 1.76 | 1.38 | 1.34 | 1.34 | 1.46 | 1.46 | 1.3 |
| 19 | 1.34 | 1.4 | 1.5 | 1.74 | 2.54 | 1.78 | 1 38 | 1.32 | 1.38 | 1.44 | 1.46 | 1.3 |
| 20 | 1.44 | 1.44 | 1.6 | 1.72 | 2.64 | 1.78 | 1.36 | 1.32 | 1.38 | 1 44 | 1.44 | 1.3 |

*Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 1.44 | 1.48 | 1.6 | 1.72 | 2.74 | 1.78 | 1.34 | 1.32 | 1.36 | 1.44 | 1.44 | 1.4 |
| 22 | 1.44 | 1.48 | 1.52 | 1.7 | 2.84 | 1.74 | 1.36 | 1.3 | 1.36 | 1.48 | 1.5 | 1.35 |
| 23 | 1.46 | 1.46 | 1.5 | 1.74 | 2.94 | 1.72 | 1.34 | 1.3 | 1.36 | 1.48 | 1.5 | 1.4 |
| 24 | 1.44 | 1.48 | 1.5 | 1.76 | 2.84 | 1.66 | 1.34 | 1.32 | 1.34 | 1.48 | 1.5 | 1.4 |
| 25 | 1.46 | 1.48 | 1.5 | 1.78 | 2.74 | 1.6 | 1.34 | 1.66 | 1.44 | 1.48 | 1.46 | 1.4 |
| 26 | 1.42 | 1.48 | 1.48 | 1.86 | 2.8 | 1.6 | 1.34 | 1.42 | 1.48 | 1.48 | 1.46 | 1.4 |
| 27 | 1.36 | 1.46 | 1.5 | 1.92 | 2.74 | 1.58 | 1.34 | 1.46 | 1.5 | 1.48 | 1.5 | 1.4 |
| 28 | 1.38 | 1.5 | 1.5 | 1.98 | 2.78 | 1.58 | 1.34 | 1.48 | 1.46 | 1.48 | 1.46 | 1.5 |
| 29 | 1.44 | ....... | 1.52 | 1.97 | 2.7 | 1.56 | 1.34 | 1.4 | 2.22 | 1.48 | 1.46 | 1.7 |
| 30 | 1.46 | ....... | 1.54 | 2.0 | 2.6 | 1.54 | 1.34 | 1.38 | 1.64 | 1.48 | 1.46 | 1.45 |
| 31 | 1.44 | ....... | 1.46 | ....... | 2.56 | ....... | 1.34 | 1.34 | ....... | 1.5 | ....... | 1.45 |

NOTE.—January 3 and 6 and February 13, backwater caused by ice; open-channel conditions during the remainder of the winter months. Gage February 6 probably in error.

*Daily discharge, in second-feet, of Spanish Fork near Spanish Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 57 | 86 | 112 | 79 | 192 | 336 | 56 | 48 | 45 | 92 | 60 | 61 |
| 2 | 39 | 106 | 104 | 76 | 187 | 329 | 54 | 46 | 45 | 76 | 60 | 59 |
| 3 | 43 | 95 | 115 | 75 | 182 | 322 | 54 | 54 | 45 | 54 | 61 | 53 |
| 4 | 47 | 95 | 100 | 71 | 168 | 292 | 48 | 48 | 89 | 54 | 61 | 59 |
| 5 | 57 | 95 | 92 | 74 | 158 | 258 | 47 | 48 | 53 | 50 | 61 | 69 |
| 6 | 59 | 91 | 92 | 74 | 136 | 252 | 49 | 48 | 50 | 53 | 62 | 53 |
| 7 | 60 | 87 | 88 | 77 | 136 | 224 | 50 | 42 | 59 | 50 | 62 | 59 |
| 8 | 61 | 87 | 88 | 81 | 140 | 212 | 51 | 42 | 53 | 50 | 62 | 59 |
| 9 | 62 | 75 | 84 | 83 | 172 | 190 | 43 | 42 | 52 | 50 | 62 | 59 |
| 10 | 66 | 79 | 83 | 127 | 168 | 188 | 46 | 46 | 52 | 60 | 62 | 53 |
| 11 | 70 | 83 | 82 | 114 | 154 | 180 | 47 | 68 | 52 | 60 | 63 | 41 |
| 12 | 64 | 52 | 78 | 113 | 145 | 168 | 44 | 52 | 52 | 59 | 63 | 35 |
| 13 | 60 | 64 | 81 | 109 | 189 | 147 | 43 | 49 | 52 | 55 | 50 | 36 |
| 14 | 69 | 76 | 85 | 100 | 195 | 132 | 46 | 49 | 52 | 55 | 56 | 54 |
| 15 | 69 | 77 | 84 | 96 | 200 | 118 | 46 | 46 | 52 | 59 | 56 | 42 |
| 16 | 74 | 65 | 76 | 112 | 203 | 116 | 46 | 44 | 52 | 59 | 56 | 36 |
| 17 | 71 | 74 | 80 | 112 | 242 | 110 | 47 | 44 | 44 | 59 | 59 | 42 |
| 18 | 72 | 71 | 79 | 102 | 286 | 112 | 44 | 44 | 44 | 56 | 59 | 42 |
| 19 | 58 | 76 | 86 | 119 | 315 | 115 | 45 | 41 | 48 | 54 | 59 | 42 |
| 20 | 77 | 83 | 105 | 114 | 335 | 113 | 43 | 41 | 48 | 54 | 57 | 42 |
| 21 | 78 | 91 | 105 | 114 | 355 | 111 | 42 | 41 | 45 | 54 | 57 | 55 |
| 22 | 79 | 91 | 89 | 111 | 375 | 102 | 43 | 38 | 45 | 59 | 67 | 48 |
| 23 | 81 | 85 | 84 | 119 | 410 | 96 | 42 | 38 | 45 | 59 | 67 | 55 |
| 24 | 80 | 89 | 84 | 122 | 384 | 81 | 42 | 41 | 43 | 59 | 67 | 55 |
| 25 | 83 | 89 | 83 | 127 | 360 | 68 | 43 | 95 | 55 | 59 | 60 | 56 |
| 26 | 76 | 89 | 79 | 144 | 382 | 67 | 43 | 53 | 62 | 60 | 60 | 56 |
| 27 | 67 | 85 | 82 | 158 | 368 | 64 | 44 | 58 | 66 | 60 | 68 | 56 |
| 28 | 70 | 94 | 82 | 172 | 383 | 65 | 44 | 62 | 58 | 60 | 61 | 74 |
| 29 | 82 | ....... | 85 | 170 | 364 | 62 | 45 | 50 | 228 | 60 | 61 | 114 |
| 30 | 85 | ....... | 88 | 178 | 340 | 58 | 45 | 47 | 92 | 60 | 61 | 65 |
| 31 | 82 | ....... | 72 | ....... | 331 | ....... | 46 | 43 | ....... | 65 | ....... | 65 |

NOTE.—Daily discharge obtained by indirect method for shifting channels. Discharge January 3 and 6 and February 13 reduced on account of backwater from ice. Discharge February 6 interpolated between February 5 and 7 on assumption that gage height of February 6 was in error.

*Estimated monthly discharge of Spanish Fork River near Spanish Fork, Utah, for 1905.*

[Drainage area, 670 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 85 | 39 | 67.7 | 4,163 | 0.101 | 0.116 |
| February | 106 | 52 | 83.2 | 4,621 | .124 | .129 |
| March | 115 | 72 | 88 | 5,411 | .131 | .151 |
| April | 178 | 71 | 111 | 6,605 | .166 | .185 |
| May | 410 | 136 | 257 | 15,800 | .384 | .443 |
| June | 336 | 58 | 156 | 9,283 | .233 | .260 |
| July | 56 | 42 | 46.1 | 2,835 | .069 | .080 |
| August | 95 | 38 | 48.6 | 2,988 | .073 | .084 |
| September | 228 | 43 | 59.3 | 3,529 | .089 | .099 |
| October | 92 | 50 | 58.5 | 3,597 | .087 | .100 |
| November | 68 | 50 | 60.7 | 3,612 | .091 | .102 |
| December | 114 | 35 | 54.7 | 3,363 | .082 | .094 |
| The year | 410 | 35 | 90.9 | 65,810 | .136 | 1.84 |

## SPANISH FORK NEAR LAKE SHORE, UTAH.

This station was established December 10, 1903, at the highway bridge on the road between Spanish Fork and Lake Shore, about 3 miles west of Spanish Fork. In May, 1904, it was reestablished at a point about 800 feet above the bridge.

As the entire normal summer flow is diverted at a point above, the station is maintained only during the spring and winter, the object being the determination of the amount of water discharged by Spanish Fork into Utah Lake.

The channel is straight for about 75 feet above and is slightly curved for 100 feet below the station. Both banks are barren and sufficiently high to prevent overflow. The bed at this point is composed of fine gravel and sand, smooth but continually shifting. The velocity ranges from 2 to 4 feet per second, and the depth from 1 foot to 3 feet. Information in regard to winter conditions are incomplete.

Discharge measurements are made from a cable and car. The cable is marked at 4-foot intervals, beginning at the right cable post, which is the initial point for soundings.

Daily gage readings are made by J. W. Bowen, a farmer. The original gage was a vertical staff driven into the bed of the stream about 10 feet below the bridge. This was abandoned at the beginning of 1905, and readings have since been taken from the new vertical gage located on the right bank near the cable. It consists of a 2 by 4 inch fir post, driven into the bed of the stream and supported at the top by a horizontal piece buried in the bank. The datum is the same as that of the old gage, but simultaneous readings will not agree, as there is considerable fall to the stream between the two gages. The gage is referred to bench marks as follows: (1) A 30-penny nail driven into a log on the west abutment of the bridge, near the northwest corner, 10.5 feet S. 18° 30′ W., from the old gage; elevation above gage datum, 11.68 feet. (2) A 20-penny nail driven into the north side of a cedar fence post, 91 feet, S. 85° 30′ E., from the gage; elevation above gage datum, 21.95 feet. (3) A United States Geological Survey standard metallic post set 197 feet S. 21° 45′ E. from the old gage; elevation above gage datum, 21.76 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 133, p 274.
Discharge: 100, p. 224; 133, p. 275.
Discharge, monthly: 133, p. 276.
Gage heights: 133, p 275.
Rating table: 133, p 276.

*Discharge measurements of Spanish Fork near Lake Shore, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 27 | H. S. Kleinschmidt | 30 | 26 | 2.57 | 4.61 | 66 |
| February 15 | do | 26 | 21 | 2.31 | 4.37 | 49 |
| March 10 | do | 28 | 18 | 2.27 | 4.12 | 42 |
| April 6 | W. G. Swendsen | 28 | 23 | 2.41 | 4.35 | 66 |
| April 20 | do | 32 | 36 | 2.67 | 4.78 | 96 |
| May 4[a] | W. P. Hardesty | 6 | 6.7 | 2.84 | 3.85 | 19 |
| May 22 | W. G. Swendsen | 24 | 15 | 2.55 | 4.05 | 38 |
| December 4 | do | 28 | 18 | 2.16 | 4.12 | 38 |

[a] 30 feet below regular station.

*Daily gage height, in feet, of Spanish Fork near Lake Shore, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. | Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.6 | 4.67 | 4.52 | 4.5 | 4.75 | ...... | 4.0 | 17 | 4.62 | 4.6 | 4.08 | 4.9 | 3.4 | ...... | 4.3 |
| 2 | 4.1 | 4.97 | 4.58 | 4.35 | 4.3 | ...... | 4.2 | 18 | 4.6 | 4.6 | 4.1 | 5.0 | 4.0 | ...... | 4.3 |
| 3 | 4.2 | 4.85 | 4.52 | 4.33 | 4.2 | ...... | 4.2 | 19 | 4.5 | 4.59 | 4.15 | 4.9 | 4.02 | ...... | 4.1 |
| 4 | 4.2 | 4.8 | 4.5 | 4.3 | 3.85 | ...... | 4.2 | 20 | 4.6 | 4.58 | 4.3 | 4.85 | 3.7 | ...... | 4.1 |
| 5 | 4.1 | 4.73 | 4.55 | 4.31 | 3.6 | ...... | 4.18 | 21 | 4.6 | 4.6 | 4.25 | 4.72 | 3.7 | ...... | 4.1 |
| 6 | 4.4 | 4.7 | 4.53 | 4.35 | 3.48 | ...... | 4.1 | 22 | 4.63 | 4.61 | 4.3 | 4.71 | 3.9 | ...... | 4.1 |
| 7 | 4.2 | 4.68 | 3.9 | 4.48 | 3.43 | ...... | 4.05 | 23 | 4.7 | 4.55 | 4.3 | 4.63 | 4.3 | ...... | 4.2 |
| 8 | 4.45 | 4.61 | 4.1 | 4.58 | 3.42 | ...... | 4.0 | 24 | 4.63 | 4.55 | 4.2 | 4.73 | 4.03 | ...... | 4.2 |
| 9 | 4.45 | 4.5 | 4.11 | 4.68 | 3.43 | ...... | ...... | 25 | 4.62 | 4.55 | 4.2 | 4.65 | 3.5 | ...... | 4.2 |
| 10 | 4.2 | 4.58 | 4.15 | 5.1 | 3.4 | ...... | 4.0 | 26 | 4.61 | 4.58 | 4.0 | 4.68 | 3.55 | ...... | 4.3 |
| 11 | 4.62 | 4.6 | 4.05 | 4.98 | 3.42 | ...... | 4.1 | 27 | 4.6 | 4.58 | 4.15 | 4.79 | 3.5 | ...... | 4.3 |
| 12 | 4.7 | 4.2 | 4.1 | 4.88 | 3.43 | ...... | 4.2 | 28 | 4.59 | 4.51 | 4.1 | 4.82 | 3.53 | ...... | 4.2 |
| 13 | 4.6 | 4.1 | 4.12 | 4.8 | 3.4 | ...... | 4.2 | 29 | 4.58 | ...... | 4.1 | 4.8 | 3.4 | ...... | 4.3 |
| 14 | 4.8 | 4.39 | 4.2 | 4.85 | 3.38 | ...... | 4.3 | 30 | 4.6 | ...... | 4.12 | 4.72 | 3.0 | 4.0 | 4.25 |
| 15 | 4.6 | 4.38 | 4.15 | 4.88 | 3.38 | ...... | 4.3 | 31 | 4.61 | ...... | 4.11 | ...... | 3.0 | ...... | ...... |
| 16 | 4.6 | 4.52 | 4.1 | 4.9 | 3.38 | ...... | 4.1 | | | | | | | | |

*Daily discharge, in second-feet, of Spanish Fork near Lake Shore, Utah., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. | Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 53.0 | 71.0 | 67.0 | 77.0 | 83.0 | ...... | 31.5 | 17 | 62.0 | 67.0 | 41.5 | 108.0 | 7.5 | ...... | 51.5 |
| 2 | 22.5 | 95.5 | 71.5 | 65.0 | 46.0 | ...... | 44.5 | 18 | 61.0 | 67.5 | 43.0 | 116.0 | 33.5 | ...... | 51.5 |
| 3 | 28.0 | 85.5 | 68.0 | 63.5 | 38.2 | ...... | 44.5 | 19 | 53.0 | 67.0 | 46.5 | 106.0 | 35.0 | ...... | 39.0 |
| 4 | 29.5 | 81.2 | 67.0 | 61.0 | 19.0 | .... | 38.5 | 20 | 61.0 | 67.0 | 58.0 | 96.0 | 18.5 | ...... | 38.0 |
| 5 | 23.0 | 76.0 | 72.0 | 62.5 | 10.3 | ...... | 43.5 | 21 | 62.0 | 69.0 | 54.0 | 89.5 | 19.3 | ...... | 38.0 |
| 6 | 41.0 | 73.0 | 71.5 | 66.0 | 7.0 | ...... | 38.0 | 22 | 65.0 | 70.5 | 58.0 | 88.0 | 28.5 | ...... | 38.0 |
| 7 | 29.5 | 72.2 | 27.5 | 76.0 | 6.5 | ...... | 34.7 | 23 | 71.0 | 66.0 | 58.0 | 80.0 | 54.5 | ...... | 44.5 |
| 8 | 45.5 | 66.0 | 39.0 | 83.5 | 6.0 | ...... | 32.0 | 24 | 65.5 | 66.5 | 51.0 | 88.0 | 36.5 | ...... | 44.5 |
| 9 | 46.0 | 58.0 | 41.5 | 92.0 | 6.5 | ...... | 32.0 | 25 | 64.5 | 67.5 | 51.5 | 80.5 | 11.2 | ...... | 44.5 |
| 10 | 30.0 | 64.5 | 42.0 | 129.0 | 6.0 | ...... | 32.0 | 26 | 65.0 | 70.5 | 38.0 | 82.0 | 13.0 | ...... | 51.5 |
| 11 | 58.5 | 66.0 | 37.5 | 117.5 | 6.5 | ...... | 38.0 | 27 | 66.0 | 71.5 | 48.0 | 90.0 | 11.0 | ...... | 51.5 |
| 12 | 66.0 | 36.0 | 41.0 | 108.0 | 7.0 | ...... | 44.5 | 28 | 64.5 | 65.5 | 45.0 | 91.0 | 12.0 | ...... | 44.5 |
| 13 | 58.5 | 30.5 | 42.5 | 100.0 | 6.5 | ...... | 44.5 | 29 | 63.5 | ...... | 45.2 | 89.0 | 7.5 | 0.0 | 51.5 |
| 14 | 75.0 | 50.0 | 48.5 | 104.0 | 6.2 | ...... | 51.5 | 30 | 65.0 | ...... | 46.5 | 80.0 | 0.0 | 32.5 | 48.0 |
| 15 | 59.0 | 49.0 | 45.5 | 106.5 | 6.5 | ...... | 51.5 | 31 | 65.5 | ...... | 46.0 | ...... | 0.0 | ...... | 48.0 |
| 16 | 60.0 | 59.5 | 42.0 | 108.0 | 6.8 | ...... | 38.5 | | | | | | | | |

NOTE.—Total flow of river diverted for irrigation May 30 to November 29. Daily discharge obtained by indirect method for shifting channels. Discharge interpolated December 9 and 31.

*Estimated monthly discharge of Spanish Fork near Lake Shore, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 75 | 22.5 | 54.2 | 3,333 |
| February | 95.5 | 30.5 | 66.0 | 3,665 |
| March | 72 | 27.5 | 50.1 | 3,080 |
| April | 129 | 61 | 90.1 | 5,361 |
| May | 83 | 0 | 17.9 | 1,101 |
| June | 0 | 0 | 0 | 0 |
| July | 0 | 0 | 0 | 0 |
| August | 0 | 0 | 0 | 0 |
| September | 0 | 0 | 0 | 0 |
| October | 0 | 0 | 0 | 0 |
| November | 32.5 | 0 | 1.08 | 64 |
| December | 51.5 | 31.5 | 42.7 | 2,626 |
| The year | 129 | 0 | 26.8 | 19,230 |

## SEVIER RIVER BASIN.

### SEVIER RIVER NEAR GUNNISON, UTAH.

Sevier River rises in the northwestern part of Kane County, in southern Utah, flows northeastward to a point near Gunnison, northwestward nearly to Leamington, and then turns sharply to the southwest and discharges into Sevier Lake.

Tributary streams are few, San Pitch River and Salina Creek being the most important. The San Pitch joins the main stream about 3 miles above the gaging station, but since its flow is used for irrigation and is completely controlled by storage reservoirs, it furnishes little of the supply. Salina Creek, which enters about 15 miles above the station, is subject to rapid run-off and during flood seasons carries an immense amount of sediment.

There is considerable irrigation from the Sevier above Gunnison, and a few small storage reservoirs control the flood discharge.

The station was established June 29, 1900. It is located at the wagon bridge over the Sevier about 4 miles west of Gunnison, on the road to Westview precinct.

The channel is straight for about 300 feet above and below the station, with banks sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel and is smooth and apparently permanent. The current is sluggish at low water, but at ordinary stages ranges from 2 to 3 feet per second. At the high-water section the velocity is greatest at the right side, decreasing somewhat uniformly toward the left, where it is low. Floating ice during the winter season may make records at certain stages impossible. There is a free flow at the low-water but not at the high-water section.

During ordinary stages discharge measurements are made from the upstream side of the bridge, the floor of which is marked at 5-foot intervals, beginning at the bridge pile to which the gage is attached, this being the initial point for soundings. At extreme low water the velocity at this point is too low for favorable results, and measurements are made by wading at a point about 75 feet below the bridge, marked by a 2 by 4 inch post on each bank. The initial point for soundings at this section is the post on the left bank.

The gage is read daily by L. H. Erickson, a farmer. The original gage is a 1 by 4 inch piece of redwood nailed vertically to a bridge pier on the right bank on the upstream side of the bridge. In January, 1905, a new 6 by 6 inch inclined gage was established at a point about 25 feet below the old one. It is fastened to double posts set in the bank. Both gages have the same datum and are referred to bench marks as follows: (1) A large spike driven into the side of a cedar post 46 feet S. 74° E. from the gage; elevation, 8.55 feet. (2) A nail in the top of railing post at the northeast corner of the bridge 13 feet north of the gage; elevation, 13.18 feet. (3) A United States Geological Survey standard iron post set in the ground 153 feet S. 84° 30′ E. from the old gage; elevation, 10.10 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS = Water-Supply Paper):

Description: WS 51, p 425; 66, p 126; 85, p 88; 100, pp 147-148; 133, pp 277-278.
Discharge: WS 51, p 425; 66, p 126; 85, p 88; 100, p 148; 133, p 278.
Discharge, monthly: Ann 22, iv, p 420; WS 75 p 197; 85, p 90; 100, p 149; 133, p 280.
Gage heights: WS 51, p 426; 66, p 126; 85, p 89; 100, pp 148-149; 133, p 279.
Hydrograph: Ann 22, iv, p 420.
Rating tables: WS 52, p 521; 66, p 176; 85, p 89; 100, p 148; 133, p 280.

*Discharge measurements of Sevier River near Gunnison, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 19[a] | C. Tanner | 50 | 123 | 2.60 | 2.25 | 320 |
| Febrary 7[a] | do | 50 | 120 | 2.50 | 2.20 | 301 |
| April 23 | W. G. Swendsen | 36 | 35 | 1.47 | .80 | 52 |
| June 19 | C. S. Jarvis | 35 | 32 | 1.51 | .76 | 49 |
| July 1 | do | 30 | 22 | .89 | .42 | 20 |
| August 11 | do | 29 | 25 | 1.17 | .53 | 30 |

[a] Measured at bridge.

*Daily gage height, in feet, of Sevier River near Gunnison, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | ...... | 2.4 | 1.1 | .72 | 2.8 | .4 | .5 | .7 | .86 | ...... | 1.14 |
| 2 | ...... | ...... | 2.4 | 1.1 | .7 | 2.86 | .4 | .5 | .7 | 1.0 | 1.16 | 1.3 |
| 3 | ...... | ...... | 2.44 | 1.1 | .7 | 2.96 | .4 | .5 | .9 | 1.0 | 1.16 | 1.2 |
| 4 | ...... | ...... | 2.34 | 1.1 | .72 | 2.7 | .4 | .5 | .86 | 1.02 | 1.16 | 1.2 |
| 5 | ...... | ...... | 2.28 | 1.14 | .7 | 2.46 | ...... | .5 | .7 | 1.06 | 1.14 | 1.14 |
| 6 | ...... | 2.3 | 2.1 | 1.1 | .7 | 2.38 | .4 | .5 | .7 | 1.06 | 1.14 | 1.16 |
| 7 | ...... | 2.2 | 1.88 | 1.1 | .7 | 2.36 | .4 | .54 | .74 | 1.08 | 1.16 | 1.16 |
| 8 | ...... | 2.2 | 1.7 | 1.12 | .76 | 2.24 | .42 | .54 | .74 | 1.1 | 1.16 | 1.18 |
| 9 | ...... | 2.16 | 1.76 | ...... | .78 | 2.2 | .4 | .54 | .76 | 1.1 | 1.14 | 1.16 |
| 10 | ...... | 2.22 | 1.96 | 1.12 | .84 | 1.76 | .4 | .54 | .9 | 1.14 | 1.14 | ...... |
| 11 | ...... | 2.18 | 1.9 | 1.12 | .96 | 1.76 | .42 | .54 | .86 | 1.16 | 1.12 | 1.16 |
| 12 | ...... | 2.26 | 1.88 | 1.06 | .98 | 1.56 | .4 | .56 | .7 | 1.18 | 1.12 | 1.18 |
| 13 | ...... | 2.6 | 1.84 | 1.0 | 1.0 | 1.2 | .4 | .56 | .7 | 1.18 | 1.12 | 1.2 |
| 14 | ...... | 3.1 | 1.8 | .9 | 1.04 | 1.1 | .4 | .56 | .72 | 1.2 | 1.12 | 1.2 |
| 15 | ...... | 2.0 | 1.76 | .9 | 1.24 | .9 | .4 | .56 | .7 | 1.18 | 1.14 | 1.18 |
| 16 | ...... | 2.0 | ...... | .86 | 1.56 | .9 | .42 | .56 | .7 | 1.14 | 1.12 | ...... |
| 17 | ...... | 2.02 | 1.64 | .84 | 1.58 | .8 | .42 | .56 | .7 | 1.1 | 1.12 | ...... |
| 18 | 2.0 | 2.0 | 1.6 | .78 | 1.6 | .82 | .4 | .56 | .7 | 1.1 | 1.1 | ...... |
| 19 | 2.25 | 2.0 | 1.58 | .8 | 1.66 | .82 | .4 | .56 | .7 | 1.1 | 1.1 | ...... |
| 20 | 2.2 | 2.0 | 1.62 | .8 | 1.7 | .76 | .4 | .58 | .7 | 1.1 | 1.1 | ...... |
| 21 | 2.2 | 2.12 | 1.56 | .78 | 1.74 | .7 | ...... | .58 | .7 | 1.12 | 1.1 | ...... |
| 22 | 2.2 | 2.22 | ...... | .78 | 1.76 | .56 | .4 | .58 | .7 | 1.16 | 1.1 | ...... |
| 23 | 2.06 | 2.26 | 1.5 | ...... | 1.94 | .52 | .4 | .6 | .72 | 1.16 | 1.12 | ...... |
| 24 | 2.2 | 2.38 | 1.4 | .9 | 2.44 | .5 | .4 | .6 | .74 | 1.16 | 1.12 | ...... |
| 25 | 2.22 | 2.38 | 1.4 | .82 | 3.25 | .46 | .4 | .6 | .74 | 1.16 | 1.12 | ...... |
| 26 | 2.24 | 2.38 | 1.34 | .78 | 3.23 | .44 | .44 | .86 | .78 | 1.14 | 1.12 | ...... |
| 27 | 2.26 | 2.3 | 1.24 | .78 | 3.3 | .42 | .44 | .96 | .78 | 1.14 | 1.14 | ...... |
| 28 | 2.22 | 2.3 | ...... | .74 | 3.32 | .4 | .52 | .8 | .8 | 1.16 | 1.14 | ...... |
| 29 | 2.22 | ...... | 1.16 | .7 | 3.22 | .4 | .52 | .74 | .82 | 1.16 | 1.14 | ...... |
| 30 | 2.26 | ...... | 1.1 | .7 | 3.24 | .4 | .5 | .7 | .86 | 1.16 | 1.14 | ...... |
| 31 | 2.24 | ...... | 1.14 | ...... | 2.6 | ...... | .5 | .7 | ...... | 1.18 | ...... | ...... |

NOTE.—River frozen January 1-17 and December 16-31.

*Station rating table for Sevier River near Gunnison, Utah, from January 18 to December 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.40 | 17 | 1.20 | 101 | 2.00 | 254 | 2.80 | 474 |
| 0.50 | 24 | 1.30 | 116 | 2.10 | 278 | 2.90 | 506 |
| 0.60 | 32 | 1.40 | 132 | 2.20 | 303 | 3.00 | 539 |
| 0.70 | 41 | 1.50 | 149 | 2.30 | 329 | 3.10 | 573 |
| 0.80 | 51 | 1.60 | 168 | 2.40 | 356 | 3.20 | 608 |
| 0.90 | 62 | 1.70 | 188 | 2.50 | 384 | 3.30 | 644 |
| 1.00 | 74 | 1.80 | 209 | 2.60 | 413 | 3.40 | 681 |
| 1.10 | 87 | 1.90 | 231 | 2.70 | 443 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 0.4 foot and 1 foot and fairly well defined above 1 foot.

*Estimated monthly discharge of Sevier River near Gunnison, Utah, for 1905.*

[Drainage area, 3,986 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 18-31 | 319 | 254 | 303 | 8,414 | 0.076 | 0.040 |
| February | 573 | 254 | 318 | 17,660 | .080 | .083 |
| March | 367 | 87 | 199 | 12,240 | .050 | .058 |
| April | 92 | 41 | 67.0 | 3,987 | .017 | .019 |
| May | 651 | 41 | 222 | 13,650 | .056 | .065 |
| June | 525 | 17 | 164 | 9,759 | .041 | .046 |
| July | 26 | 17 | 18.4 | 1,131 | .0046 | .0053 |
| August | 69 | 24 | 32.3 | 1,986 | .0081 | .0093 |
| September | 62 | 41 | 46.2 | 2,749 | .012 | .013 |
| October | 101 | 58 | 89.3 | 5,491 | .022 | .025 |
| November | 95 | 87 | 91.4 | 5,439 | .023 | .026 |
| December 1-15 | 116 | 93 | 98.3 | 2,925 | .025 | .014 |
| The period | | | | 85,430 | | |

NOTE.—Discharge interpolated on days when gage heights were missing.

## SAN PITCH RIVER NEAR GUNNISON, UTAH.

San Pitch River, which enters Sevier River from the north, flows throughout its course in a well-defined channel with no overflow. Over the lower portions of the area evaporation and seepage doubtless exceed inflow to the stream. There are small tracts of irrigated land at various points along the river, and a storage reservoir about 10 miles above the gaging station completely controls the flow. The tributaries are few and mostly intermittent. Manti Creek, which enters at a point about 11 miles above the station, drains a barren area and is subject to rapid run-off. Its discharge may vary from 4 to 150 second-feet, but it enters above the reservoir dam and is thus completely controlled before reaching the gaging station.

The station was established June 30, 1900. It is located 4 miles northeast of Gunnison about one-eighth mile west of the Rio Grande Western Railway, west of the second farmhouse along the railroad track north of Gunnison station.

The channel is straight for about 100 feet above and is slightly curved below the station. Both banks slope gradually and are sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel, and is smooth and apparently permanent. The velocity is high. Information in regard to winter conditions is indefinite.

Discharge measurements are made by wading at a point near the gage, where a tagged wire is stretched. The initial point for soundings is the west side of the supporting post on the left bank.

The gage, which is read daily by Oliver Peterson, is a vertical staff driven into the stream bed. It is referred to bench marks as follows: (1) The top of a cedar post set about 45.5 feet west from the gage; elevation, 5.96 feet. (2) Top of nail driven into top of stake set about 150 feet S. 84° E. from the initial point; elevation, 10.36 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge, monthly: Ann 22, iv, p 419; WS 75, p 196; 85, p 96; 100, p 152; 133, p 283.
Gage heights: WS 51, p 425; 66, p 125; 85, p 95; 100, p 151; 133, p 282.
Hydrograph: Ann 22, iv, p 419.
Rating tables: WS 52, p 521; 66, p 176; 85, p 95; 100, p 151; 133, p 282.

*Discharge measurements of San Pitch River near Gunnison, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 18 | C. Tanner | 23 | 20 | 0.60 | 1.76 | 12 |
| June 19 | C. S. Jarvis | 31 | 40 | 2.92 | 2.46 | 116 |
| July 1 | do | 29 | 36 | 2.63 | 2.40 | 96 |
| August 12 | do | 29 | 40 | 2.88 | 2.46 | 114 |

*Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.78 | 1.78 | 1.8 | 1.76 | 2.44 | 3.0 | 2.44 | 2.54 | 2.0 | 2.08 | 1.96 | 1.9 |
| 2 | 1.78 | 1.9 | 1.78 | 1.78 | 2.4 | 2.9 | 2.56 | 2.5 | 2.06 | 2.04 | 1.96 | 1.9 |
| 3 | 1.78 | 1.9 | 1.78 | 1.78 | 2.3 | 2.76 | 2.54 | 2.52 | 2.04 | 2.04 | 2.0 | 1.9 |
| 4 | 1.78 | 1.9 | 1.76 | 1.78 | 2.3 | 2.8 | 2.54 | 2.5 | 2.06 | 2.02 | 2.0 | 1.9 |
| 5 | 1.8 | 1.88 | 1.76 | 1.78 | 2.3 | 3.1 | 2.5 | 2.5 | 2.08 | 2.02 | 1.98 | 1.9 |
| 6 | 1.8 | 1.88 | 1.76 | 1.78 | 2.36 | 2.82 | 2.58 | 2.5 | 2.08 | 2.02 | 1.96 | 1.92 |
| 7 | 1.8 | 1.86 | 1.74 | 1.8 | 2.3 | 2.88 | 2.6 | 2.5 | 2.02 | 2.0 | 1.96 | 1.9 |
| 8 | 1.78 | 1.84 | 1.7 | 1.8 | 2.32 | 2.9 | 2.68 | 2.5 | 2.04 | 2.0 | 1.96 | 1.88 |
| 9 | 1.78 | 1.8 | 1.7 | 1.8 | 2.5 | 2.88 | 2.66 | 2.5 | 2.02 | 2.0 | 1.98 | 1.88 |
| 10 | 1.78 | 1.74 | 1.68 | 1.84 | 2.5 | 2.86 | 2.64 | 2.5 | 2.02 | 2.0 | 1.96 | 1.88 |
| 11 | 1.8 | 1.74 | 1.68 | 1.8 | 2.5 | 3.0 | 2.66 | 2.5 | 2.04 | 1.94 | 1.92 | 1.88 |
| 12 | 1.8 | 1.72 | 1.7 | 1.8 | 2.5 | 3.14 | 2.64 | 2.56 | 2.02 | 1.94 | 1.92 | 1.88 |
| 13 | 1.73 | 1.7 | 1.72 | 1.8 | 2.52 | 2.88 | 2.64 | 2.46 | 2.0 | 1.94 | 1.92 | 1.9 |
| 14 | 1.78 | 1.7 | 1.73 | 1.8 | 2.6 | 2.9 | 2.6 | 2.44 | 2.06 | 1.94 | 1.92 | 1.9 |
| 15 | 1.76 | 1.7 | 1.78 | 1.8 | 2.6 | 2.88 | 2.64 | 2.44 | 2.06 | 1.94 | 1.92 | 1.9 |
| 16 | 1.78 | 1.68 | 1.78 | 1.8 | 2.78 | 2.8 | 2.64 | 2.46 | 2.04 | 1.92 | 1.92 | 1.9 |
| 17 | 1.78 | 1.68 | 1.78 | 1.82 | 2.74 | 2.7 | 2.6 | 2.42 | 2.03 | 1.94 | 1.92 | 1.92 |
| 18 | 1.76 | 1.68 | 1.78 | 1.84 | 2.52 | 2.78 | 2.6 | 2.4 | 2.02 | 1.94 | 1.94 | 1.92 |
| 19 | 1.78 | 1.68 | 1.78 | 1.84 | 2.8 | 2.6 | 2.6 | 2.36 | 2.02 | 1.94 | 1.94 | 1.94 |
| 20 | 1.76 | 1.68 | 1.8 | 1.84 | 2.34 | 2.52 | 2.6 | 2.36 | 2.02 | 1.96 | 1.96 | 1.96 |

*Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905*—Continued.

| Daily. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 1.74 | 1.68 | 1.8 | 1.84 | 2.54 | 2.4 | 2.6 | 2.36 | 2.02 | 1.96 | 2.0 | 1.96 |
| 22 | 1.74 | 1.78 | 1.8 | 1.8 | 3.24 | 2.5 | 2.6 | 2.36 | 2.02 | 1.96 | 2.0 | 1.96 |
| 23 | 1.74 | 1.72 | 1.78 | 1.82 | 2.8 | 2.42 | 2.58 | 2.36 | 2.02 | 1.96 | 1.88 | 1.96 |
| 24 | 1.74 | 1.74 | 1.78 | 1.88 | 2.78 | 2.44 | 2.54 | 2.36 | 2.0 | 1.96 | 1.88 | 1.9 |
| 25 | 1.74 | 1.78 | 1.78 | 1.8 | 2.7 | 2.38 | 2.54 | 2.36 | 2.0 | 1.96 | 1.88 | 1.86 |
| 26 | 1.74 | 1.78 | 1.66 | 1.9 | 2.6 | 2.34 | 2.54 | 2.3 | 2.0 | 1.96 | 1.9 | 1.86 |
| 27 | 1.74 | 1.78 | 1.66 | 2.0 | 2.5 | 2.42 | 2.54 | 2.24 | 2.0 | 1.96 | 1.92 | 1.86 |
| 28 | 1.76 | 1.8 | 1.68 | 2.34 | 2.6 | 2.4 | 2.54 | 2.22 | 1.96 | 1.96 | 1.9 | 1.86 |
| 29 | 1.74 | ....... | 1.66 | 2.34 | 2.4 | 2.42 | 2.56 | 4.15 | 2.3 | 1.96 | 1.9 | 1.86 |
| 30 | 1.74 | ....... | 1.68 | 2.36 | 2.32 | 2.42 | 2.56 | 2.36 | 2.08 | 1.96 | 1.9 | 1.86 |
| 31 | 1.74 | ....... | 1.73 | ....... | 2.6 | ....... | 2.56 | 2.2 | ....... | 1.96 | ....... | 1.86 |

*Station rating table for San Pitch River near Gunnison, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 10 | 2.10 | 49 | 2.50 | 123 | 2.90 | 227 |
| 1.80 | 15 | 2.20 | 64 | 2.60 | 146 | 3.00 | 258 |
| 1.90 | 24 | 2.30 | 82 | 2.70 | 171 | 3.10 | 290 |
| 2.00 | 35 | 2.40 | 102 | 2.80 | 198 | 3.20 | 324 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is well defined between gage heights 1.65 feet and 2.5 feet.

*Estimated monthly discharge of San Pitch River near Gunnison, Utah, for 1905.*

[Drainage area, 836 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 15 | 11 | 13.3 | 818 | 0.016 | 0.018 |
| February | 24 | 9 | 14.1 | 783 | .017 | .018 |
| March | 15 | 8 | 12.1 | 744 | .014 | .016 |
| April | 94 | 13 | 24.2 | 1,440 | .029 | .032 |
| May | 338 | 82 | 136 | 8,362 | .163 | .188 |
| June | 304 | 90 | 179 | 10,650 | .214 | .239 |
| July | 166 | 110 | 143 | 8,793 | .171 | .197 |
| August | 720 | 64 | 126 | 7,747 | .151 | .174 |
| September | 82 | 30 | 40.5 | 2,410 | .048 | .054 |
| October | 46 | 26 | 32.0 | 1,968 | .038 | .044 |
| November | 35 | 22 | 28.1 | 1,672 | .034 | .038 |
| December | 30 | 20 | 23.9 | 1,470 | .029 | .033 |
| The year | 338 | 8 | 64.3 | 46,860 | .077 | 1.05 |

NOTE.—Open-channel curve assumed to apply throughout the year as the stream is known to freeze but slightly at this station.

## HUMBOLDT SINK DRAINAGE.

The only stream of importance draining into Humboldt Sink is Humboldt River, the basin of which is described below.

## HUMBOLDT RIVER BASIN.

### DESCRIPTION OF BASIN.

Humboldt River rises in the extreme northeastern part of Nevada, flows west and southwest across the structural features of the country, and enters Humboldt Lake, whence its waters find their way into Humboldt Sink. The tributaries follow the general direction of the mountain ranges and flow either to the north or to the south. During low stages the water of the river is almost wholly diverted, and for the future development of the country recourse must be had to the construction of storage reservoirs.

Of the tributaries, North Fork enters the stream west of Peko, Nev., and South Fork about 10 miles below Elko. Pine Creek comes in from the south near Palisade, Nev. Marys River is one of the headwater branches.

### NORTH FORK OF HUMBOLDT RIVER NEAR ELBURZ, NEV.

This station was established October 10, 1902. It is located about one-fourth mile above the junction of North Fork with the main River and 150 feet below the Southern Pacific Railroad bridge. It is 2 miles west of the Southern Pacific Railroad station at Elburz. The nearest post-office is Halleck, Nev.

The channel is straight for 150 feet above and below the station. Both banks are high, but the left will overflow at extreme flood stages. The bed of the stream is composed of gravel and silt and changes slightly. There is but one channel at all stages, and the current is sluggish.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by A. R. Blevins, is an inclined 4 by 4 inch timber fastened to the left bank just above the cable. The bench mark is a 4 by 4 inch timber driven into the ground on the left bank 20 feet upstream from the gage; elevation above zero of gage, 6.99 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 163; 133, p 283.
Discharge: 100, p 164; 133, p 284.
Discharge, monthly: 133, p 285.
Gage heights: 100, p 164; 133, p 284.
Rating table: 133, p 285.

*Discharge measurements of North Fork of Humboldt River near Elburz, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 27 | W. A. Wolf | 37 | 26 | 1.13 | 3.30 | 29.5 |
| May 20 | do | 37 | 27 | 1.18 | 3.35 | 32 |
| June 4 | do | 37 | 32 | 1.25 | 3.50 | 40 |
| July 14 | do | | | | 2.80 | [a] 1 |

[a] Discharge estimated.

*Daily gage height, in feet, of North Fork of Humboldt River near Elburz, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.6 | 3.5 | 3.4 | 3.5 | 3.4 | 3.55 | 2.85 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 2 | 3.6 | 3.5 | 3.4 | 3.5 | 3.5 | 3.55 | 2.85 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 3 | 3.6 | 3.45 | 3.45 | 3.45 | 3.55 | 3.5 | 2.8 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 4 | 3.6 | 3.4 | 3.45 | 3.45 | 3.55 | 3.55 | 2.8 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 5 | 3.6 | 3.35 | 3.5 | 3.4 | 3.6 | 3.5 | 2.8 | 2.2 | 2.55 | 2.6 | 3.2 | 3.0 |
| 6 | 3.55 | 3.35 | 3.5 | 3.35 | 3.6 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.1 | 3.0 |
| 7 | 3.55 | 3.35 | 3.5 | 3.35 | 3.6 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.0 | 3.0 |
| 8 | 3.6 | 3.3 | 3.5 | 3.3 | 3.65 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.0 | 3.0 |
| 9 | 3.6 | 3.25 | 3.5 | 3.3 | 3.7 | 3.5 | 2.85 | 2.15 | 2.55 | 2.6 | 2.9 | 3.0 |
| 10 | 3.55 | 3.2 | 3.5 | 3.3 | 3.65 | 3.45 | 2.85 | 2.15 | 2.55 | 2.6 | 2.9 | 3.0 |
| 11 | 3.55 | 3.15 | 3.5 | 3.3 | 3.6 | 3.4 | 2.85 | 2.15 | 2.5 | 2.6 | 3.0 | 3.0 |
| 12 | 3.55 | 3.3 | 3.4 | 3.3 | 3.65 | 3.35 | 2.85 | 2.15 | 2.5 | 2.6 | 3.0 | 3.0 |
| 13 | 3.55 | 3.35 | 3.4 | 3.25 | 3.7 | 3.3 | 2.8 | 2.15 | 2.5 | 2.6 | 2.9 | 3.0 |
| 14 | 3.55 | 3.4 | 3.4 | 3.25 | 3.6 | 3.3 | 2.8 | 2.15 | 2.5 | 2.6 | 2.9 | 3.0 |
| 15 | 3.6 | 3.4 | 3.4 | 3.2 | 3.5 | 3.35 | 2.8 | 2.15 | 2.5 | 2.6 | 2.8 | 3.0 |
| 16 | 3.6 | 3.4 | 3.45 | 3.25 | 3.5 | 3.4 | 2.75 | 2.15 | 2.5 | 2.6 | 2.8 | 3.0 |
| 17 | 3.6 | 3.35 | 3.45 | 3.25 | 3.45 | 3.4 | 2.75 | 2.15 | 2.5 | 2.6 | 2.7 | 3.1 |
| 18 | 3.6 | 3.3 | 3.5 | 3.3 | 3.4 | 3.3 | 2.75 | 2.15 | 2.5 | 2.6 | 2.7 | 3.1 |
| 19 | 3.6 | 3.3 | 3.5 | 3.3 | 3.35 | 3.25 | 2.75 | 2.15 | 2.55 | 2.6 | 2.7 | 3.1 |
| 20 | 3.8 | 3.3 | 3.5 | 3.3 | 3.35 | 3.2 | 2.7 | 2.15 | 2.55 | 2.6 | 2.7 | 3.2 |
| 21 | 3.8 | 3.3 | 3.5 | 3.35 | 3.3 | 3.15 | 2.7 | 2.15 | 2.6 | 2.6 | 2.7 | 3.2 |
| 22 | 3.8 | 3.3 | 3.5 | 3.35 | 3.35 | 3.15 | 2.7 | 2.2 | 2.6 | 2.6 | 2.7 | 3.3 |
| 23 | 3.75 | 3.25 | 3.5 | 3.3 | 3.4 | 3.15 | 2.65 | 2.3 | 2.6 | 2.7 | 2.7 | 3.4 |
| 24 | 3.7 | 3.3 | 3.45 | 3.3 | 3.45 | 3.15 | 2.65 | 2.4 | 2.6 | 2.7 | 2.7 | 3.4 |
| 25 | 3.6 | 3.3 | 3.45 | 3.25 | 3.55 | 3.1 | 2.6 | 2.5 | 2.6 | 2.8 | 2.7 | 3.5 |
| 26 | 3.6 | 3.3 | 3.5 | 3.3 | 3.55 | 3.1 | 2.55 | 2.5 | 2.6 | 2.9 | 2.8 | 3.5 |
| 27 | 3.6 | 3.25 | 3.5 | 3.3 | 3.6 | 3.1 | 2.4 | 2.5 | 2.6 | 2.9 | 2.85 | 3.5 |
| 28 | 3.6 | 3.3 | 3.45 | 3.3 | 3.6 | 3.0 | 2.32 | 2.55 | 2.6 | 3.0 | 2.9 | 3.5 |
| 29 | 3.6 | ...... | 3.45 | 3.35 | 3.6 | 3.0 | 2.3 | 2.55 | 2.6 | 3.1 | 3.0 | 3.5 |
| 30 | 3.55 | ...... | 3.45 | 3.4 | 3.55 | 3.0 | 2.25 | 2.6 | 2.6 | 3.2 | 3.0 | 3.5 |
| 31 | 3.5 | ...... | 3.5 | ...... | 3.6 | ...... | 2.2 | 2.6 | ...... | 3.3 | ...... | ...... |

NOTE.—Ice conditions exist at this station during the winter months. Ice 8 inches thick January 20.

*Station rating table for North Fork of Humboldt River near Elburz, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.30 | 0.0 | 2.70 | 0.8 | 3.10 | 14 | 3.50 | 41 |
| 2.40 | .2 | 2.80 | 1. | 3.20 | 20 | 3.60 | 49 |
| 2.50 | .4 | 2.90 | 3. | 3.30 | 27 | 3.70 | 57 |
| 2.60 | .6 | 3.00 | 8. | 3.40 | 34 | 3.80 | 66 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. Estimates based on this table can be considered only as approximate, and especially so for low stages. Zero flow at 2.3 feet is based on observer's statement.

*Estimated monthly discharge of North Fork of Humboldt River near Elburz, Nev., for 1905.*

[Drainage area, 1,020 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 66 | 41 | 53.3 | 3,277 | 0.052 | 0.060 |
| February | 41 | 17 | 29.0 | 1,611 | .028 | .029 |
| March | 41 | 34 | 38.8 | 2,386 | .038 | .044 |
| April | 41 | 20 | 28.9 | 1,720 | .028 | .031 |
| May | 57 | 27 | 43.8 | 2,693 | .043 | .050 |
| June | 45 | 8 | 28.0 | 1,666 | .027 | .030 |
| July | 2 | .0 | .96 | 59 | .00094 | .0011 |
| August | .6 | .0 | .12 | 7 | .00012 | .00014 |
| September | .6 | .4 | .50 | 30 | .00049 | .00055 |
| October | 27 | .6 | 2.9 | 178 | .0028 | .0032 |
| November | 27 | .8 | 7.8 | 464 | .0076 | .0085 |
| December | 41 | 8 | 19.1 | 1,174 | .019 | .022 |
| The year | 66 | 0 | 21.1 | 15,270 | .021 | .279 |

NOTE.—Open-channel rating table applied to the winter months without correction. Winter estimates liable to some error.

## SOUTH FORK OF HUMBOLDT RIVER NEAR ELKO, NEV.

This station was established August 29, 1896. It is located 10 miles southwest of the town of Elko, at Cislini's (formerly Mason's) ranch, and about 6 miles above the junction of South Fork with the main stream.

The channel is straight for some distance above and below the station and the banks are high. The bed of the stream is composed of gravel and is stable. There is a good site for a reservoir a short distance above the station.

Discharge measurements are made from a cable and suspended car at a point 1 mile above the gage.

The gage, which is placed near the farm of the observer, M. Cislini, for his convenience, is inclined and is spiked to posts driven firmly into the right bank. An inclined gage was installed November 22, 1902, at the site of the old one, the 4-foot marks of the old and new gages coinciding. The bench mark is a 4 by 4 inch timber driven 4 feet south of the gage; elevation above gage datum, 6.29 feet. A new gage was installed May 21, 1905, below a dam which was built just below the old gage. All gage heights for 1905 have been referred to this new datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 311; WS 16, p 156; 28, p 146; 38 pp 327-328; 51, p 396; 66, p 105; 85, p 101; 100, p 161; 133, p 294.

Discharge: Ann 18, iv, p 311; WS 16, p 156; 28, p 153; 38, p 328; 51, p 396; 66, p 105; 85, p 102; 100, p 161; 133, p 295.

Discharge, monthly: Ann 19, iv, p 430; 20, iv, p 440; 21, iv, p 391; 22, iv, p 400; WS 75, p 182; 85, p 103; 100, p 163; 133, p 296.

Discharge, yearly: Ann 20, iv, p 60.

Gage heights: WS 11, p 76; 16, p 165; 28, pp 148-149; 38, p 328; 51, p 397; 66, p 106; 85, p 102; 100, p 162; 133, p 295.

Hydrographs: Ann 19, iv, p 430; 20, iv, p 441; 21, iv, p 391; 22, iv, p 400.

Rating tables: Ann 19, iv, p 429; WS 28, p 154; 39, p 452; 52, p 520; 66, p 174; 85, p 102; 100, p 162; 133, p 296.

*Discharge measurements of South Fork of Humboldt River near Elko, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 26 | W. A. Wolf | | 109 | 2.24 | 1.55 | 244 |
| May 21 | do | 47 | 167 | 3.81 | 3.85 | 636 |
| June 4 | do | 46 | 157 | 3.62 | 3.60 | 568 |
| June 16 | do | 46 | 181 | 4.30 | 4.31 | 779 |
| June 27 | do | 45 | 122 | 2.89 | 2.88 | 324 |
| July 14 | do | 45 | 86 | 1.40 | 1.95 | 120 |
| September 7 | do | | | | .60 | [a].5 |

[a] Estimated.

NOTE.—Beginning May 21 gage heights refer to new datum.

*Daily gage height, in feet, of South Fork Humboldt River near Elko, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 0.85 | (a) | 0.4 | 2.3 | 3.55 | 2.75 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 2 | .5 | 1.15 | (a) | .5 | 2.1 | 3.6 | 2.75 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 3 | .5 | 1.15 | (a) | .5 | 2.3 | 3.6 | 2.8 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 4 | .5 | 1.5 | (a) | 1.15 | 2.55 | 3.7 | 2.9 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 5 | .5 | 1.5 | (a) | 1.15 | 2.55 | 3.7 | 3.0 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 6 | .5 | 1.5 | 0.4 | 1.5 | 2.55 | 3.6 | 3.7 | 1.0 | 1.0 | 0 | 1.1 | 1.1 |
| 7 | .5 | 1.15 | .4 | 1.65 | 2.75 | 3.7 | 2.9 | 1.0 | 1.0 | 0 | 1.1 | 1.1 |
| 8 | .5 | .5 | (a) | 1.8 | 2.9 | 3.8 | 2.7 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 9 | .5 | .5 | (a) | 1.8 | 3.0 | 3.9 | 2.6 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 10 | .5 | .5 | .4 | 2.1 | 3.15 | 3.8 | 2.5 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 11 | .5 | .5 | .4 | 2.3 | 3.15 | 3.8 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 12 | .5 | .5 | .4 | 2.1 | 3.3 | 3.9 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 13 | .5 | .4 | .4 | 2.1 | 3.35 | 4.0 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 14 | .5 | .4 | .4 | 1.8 | 3.4 | 4.1 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 15 | .5 | (a) | .4 | 1.8 | 3.5 | 4.2 | 2.45 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 16 | .5 | (a) | .4 | 2.1 | 3.65 | 4.3 | 2.4 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 17 | .5 | (a) | .4 | 2.1 | 3.75 | 4.4 | 2.2 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 18 | .5 | (a) | .4 | 2.2 | 3.85 | 4.3 | 2.1 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 19 | .5 | (a) | .4 | 2.2 | 3.85 | 4.1 | 2.0 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 20 | .5 | (a) | .4 | 2.3 | 3.85 | 4.0 | 1.8 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 21 | .5 | (a) | .4 | 2.3 | 3.8 | 3.8 | 1.7 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 22 | .5 | (a) | .4 | 2.55 | 3.7 | 3.7 | 1.6 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 23 | .5 | (a) | .4 | 2.55 | 3.7 | 3.5 | 1.5 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 24 | .5 | (a) | .4 | 2.55 | 3.6 | 3.3 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 25 | .5 | (a) | .4 | 2.55 | 3.6 | 3.2 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 26 | .5 | .4 | .4 | 2.55 | 3.5 | 3.1 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 27 | .5 | .4 | 4 | 2.55 | 3.5 | 3.0 | 1.3 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 28 | .5 | .4 | .4 | 2.55 | 3.6 | 3.0 | 1.3 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 29 | .5 | | .4 | 2.55 | 3.5 | 2.9 | 1.2 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 30 | .5 | | .5 | 2.3 | 3.55 | 2.8 | 1.1 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 31 | .5 | | .4 | | 3.55 | | 1.1 | 1.0 | | 1.0 | | 1.1 |

[a] No flow.

*Station rating table for South Fork Humboldt River near Elko, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 0 | 1.70 | 88 | 2.90 | 350 | 4.10 | 720 |
| .60 | 1 | 1.80 | 102 | 3.00 | 380 | 4.20 | 752 |
| .70 | 3 | 1.90 | 117 | 3.10 | 410 | 4.30 | 784 |
| .80 | 7 | 2.00 | 133 | 3.20 | 440 | 4.40 | 816 |
| .90 | 12 | 2.10 | 150 | 3.30 | 470 | 4.50 | 848 |
| 1.00 | 18 | 2.20 | 168 | 3.40 | 500 | 4.60 | 880 |
| 1.10 | 25 | 2.30 | 189 | 3.50 | 530 | 4.70 | 912 |
| 1.20 | 33 | 2.40 | 212 | 3.60 | 560 | 4.80 | 944 |
| 1.30 | 42 | 2.50 | 238 | 3.70 | 592 | 4.90 | 976 |
| 1.40 | 52 | 2.60 | 264 | 3.80 | 624 | 5.00 | 1,008 |
| 1.50 | 63 | 2.70 | 292 | 3.90 | 656 | | |
| 1.60 | 75 | 2.80 | 320 | 4.00 | 688 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1905. It is fairly well defined between gage heights 2 feet and 4 feet. Below 2 feet the table is based on one measurement at 0.6 foot.

*Estimated monthly discharge of South Fork Humboldt River near Elko, Nev., for 1905.*

[Drainage area, 1,150 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 0 | 0 | 0 | 0 | 0 | 0 |
| February | 63 | 0 | 10.2 | 567 | .0089 | .0093 |
| March | 0 | 0 | 0 | 0 | 0 | 0 |
| April | 251 | 0 | 149 | 8,866 | .130 | .145 |
| May | 640 | 150 | 465 | 28,590 | .404 | .466 |
| June | 816 | 320 | 588 | 34,990 | .511 | .570 |
| July | 592 | 25 | 187 | 11,500 | .163 | .188 |
| August | 18 | 18 | 18 | 1,107 | .016 | .018 |
| September | 18 | 0 | 4.7 | 280 | .0041 | .0046 |
| October | 18 | 0 | 9.9 | 608 | .0086 | .0099 |
| November | 25 | 18 | 24.7 | 1,470 | .021 | .023 |
| December | 25 | 25 | 25 | 1,537 | .022 | .025 |
| The year | 816 | 0 | 123 | 89,520 | .107 | 1.46 |

## HUMBOLDT RIVER AT PALISADE, NEV.

This station was established November 27, 1902. It is located at the single-span highway bridge one-fourth mile from the hotel at Palisade, Nev. There is a railroad bridge about 500 feet below.

The channel is straight for 200 feet above and 300 feet below the station. The right bank is low and liable to overflow; the left is high. The bed of the stream is composed of gravel and sand and is permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car about one-fourth mile above the gage. At very low stages, when the current becomes sluggish at the cable, measurements are made by wading a short distance above. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by T. H. Jewell, the hotel keeper, is a vertical 1 by 4 inch board spiked to the right abutment of the bridge. The bench mark consists of a spike and three nails driven into the bridge abutment to which the gage is fastened; elevation above zero of gage, 7.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 85, p 100; 100, p 157; 133, p 286.
**Dishcarge:** 100, p 158; 133, p 286.
**Discharge, monthly:** 100, p 159; 133, p 288.
**Gage heights:** 85, p 100; 100, p 158; 133, p 287.
**Rating table** 100, p 159; 133, p 287.

*Discharge measurements of Humboldt River at Palisade, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 27 | W. A. Wolf | 102 | 258 | 1.88 | 3.10 | 485 |
| May 20 | ....do | 105 | 365 | 2.33 | 4.10 | 850 |
| June 4 | ....do | 105 | 414 | 2.23 | 4.20 | 923 |
| June 20 | ....do | 105 | 358 | 2.12 | 3.85 | 759 |
| June 27 | ....do | 105 | 358 | 2.11 | 3.85 | 756 |
| July 15 | ....do | 97 | 204 | 1.40 | 2.35 | 284 |
| September 8 | ....do | 10 | 10 | 1.30 | .90 | 13 |

*Daily gage height, in feet, of Humboldt River at Palisade, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.9 | 2.0 | 2.4 | 2.6 | 2.95 | 4.6 | 3.2 | 1.6 | 1.1 | 1.15 | 1.4 | 1.4 |
| 2 | 1.95 | 2.1 | 2.4 | 2.6 | 3.0 | 4.6 | 3.2 | 1.6 | 1.1 | 1.15 | 1.4 | 1.4 |
| 3 | 1.95 | 2.1 | 2.4 | 2.6 | 3.05 | 4.6 | 3.15 | 1.6 | 1 1 | 1.15 | 1.4 | 1.46 |
| 4 | 1.95 | 2.2 | 2.4 | 2.6 | 3.1 | 4.55 | 3.1 | 1.6 | 1.1 | 1.15 | 1.4 | 1.46 |
| 5 | 1.95 | 2.2 | 2.4 | 2.6 | 3.15 | 4.55 | 3.1 | 1.55 | 1.1 | 1.2 | 1.4 | 1.46 |
| 6 | 1.95 | 2.2 | 2.4 | 2.6 | 3.2 | 4.55 | 3.0 | 1.55 | 1.1 | 1.2 | 1.4 | 1.46 |
| 7 | 1.95 | 2.2 | 2.4 | 2.6 | 3.3 | 4.5 | 2.9 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 8 | 1.9 | 2.2 | 2.4 | 2.6 | 3.3 | 4.5 | 2.85 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 9 | 1.9 | 2.1 | 2.4 | 2.6 | 3.35 | 4.5 | 2.8 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 10 | 1.8 | 2.1 | 2.4 | 2.6 | 3.4 | 4.45 | 2.75 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 11 | 1.8 | 2.1 | 2.4 | 2.65 | 3.5 | 4.45 | 2.7 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 12 | 1.7 | 2.0 | 2.4 | 2.75 | 3.5 | 4.4 | 2.6 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 13 | 1.7 | 2.0 | 2.4 | 2.8 | 3.6 | 4.2 | 2.5 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 14 | 1.7 | 2.0 | 2.4 | 2.8 | 3.65 | 4.0 | 2.4 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 15 | 1.7 | 2.0 | 2.4 | 2.8 | 3.7 | 4.0 | 2.3 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 16 | 1.7 | 2.0 | 2.4 | 2.9 | 3.8 | 4.0 | 2.3 | 1.5 | 1.1 | 1.25 | 1.4 | 1.4 |
| 17 | 1.7 | 2.0 | 2.4 | 2.9 | 3.9 | 3.95 | 2.3 | 1.4 | 1.1 | 1.25 | 1.4 | 1.45 |
| 18 | 1.7 | 2.1 | 2.4 | 2.9 | 4.0 | 3.9 | .2 | 1.3 | 1.1 | 1.3 | 1.4 | 1.45 |
| 19 | 1.75 | 2.1 | 2.4 | 2.9 | 4.0 | 3.9 | 2.1 | 1.25 | 1.1 | 1.3 | 1.4 | 1.45 |
| 20 | 1.75 | 2.1 | 2.4 | 2.95 | 4.2 | 3.85 | 2.0 | 1.2 | 1.1 | 1.3 | 1.4 | 1.5 |
| 21 | 1.8 | 2.2 | 2.45 | 2.95 | 4.2 | 3.85 | 2.0 | 1.15 | 1.1 | 1.3 | 1.4 | 1.5 |
| 22 | 1.8 | 2.2 | 2.5 | 2.95 | 4.2 | 3.8 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.5 |
| 23 | 1.8 | 2.2 | 2.5 | 2.95 | 4.2 | 3.8 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.5 |
| 24 | 1.85 | 2.3 | 2.5 | 2.95 | 4.3 | 3.7 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 25 | 1.95 | 2.3 | 2.55 | 2.95 | 4.4 | 3.7 | 1.8 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 26 | 1.9 | 2.4 | 2.6 | 2.95 | 4.5 | 3.6 | 1.75 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 27 | 1.9 | 2.4 | 2.6 | 2.95 | 4.6 | 3.5 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.6 |
| 28 | 1.9 | 2.4 | 2.6 | 2.95 | 4.7 | 3.4 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.6 |
| 29 | 1.9 | ....... | 2.6 | 2.95 | 4.8 | 3.3 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.65 |
| 30 | 2.0 | ....... | 2.6 | 2.95 | 4.7 | 3.2 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.7 |
| 31 | 2.0 | ....... | 2.6 | ....... | 4.6 | ....... | 1.6 | 1.1 | ....... | 1.4 | ....... | 1.7 |

*Station rating table for Humboldt River at Palisade, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 34 | 2.10 | 203 | 3.10 | 498 | 4.00 | 850 |
| 1.20 | 46 | 2.20 | 227 | 3.20 | 534 | 4.10 | 895 |
| 1.30 | 59 | 2.30 | 253 | 3.30 | 570 | 4.20 | 940 |
| 1.40 | 72 | 2.40 | 280 | 3.40 | 607 | 4.30 | 985 |
| 1.50 | 86 | 2.50 | 306 | 3.50 | 645 | 4.40 | 1,030 |
| 1.60 | 102 | 2.60 | 337 | 3.60 | 684 | 4.50 | 1,075 |
| 1.70 | 120 | 2.70 | 367 | 3.70 | 724 | 4.60 | 1,120 |
| 1.80 | 139 | 2.80 | 398 | 3.80 | 765 | 4.70 | 1,170 |
| 1.90 | 159 | 2.90 | 430 | 3.90 | 807 | 4.80 | 1,220 |
| 2.00 | 180 | 3.00 | 463 | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is fairly well defined.

*Estimated monthly discharge of Humboldt River at Palisade, Nev., for 1905.*

[Drainage area, 5,014 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 180 | 120 | 149 | 9,162 | 0.030 | 0.035 |
| February | 280 | 180 | 216 | 12,000 | .043 | .045 |
| March | 337 | 280 | 296 | 18,200 | .059 | .068 |
| April | 446 | 337 | 397 | 23,620 | .079 | .088 |
| May | 1,220 | 446 | 793 | 48,760 | .158 | .182 |
| June | 1,120 | 534 | 884 | 52,600 | .176 | .196 |
| July | 534 | 102 | 286 | 17,580 | .057 | .066 |
| August | 102 | 34 | 66.6 | 4,095 | .013 | .015 |
| September | 34 | 34 | 34.0 | 2,023 | .0068 | .0076 |
| October | 72 | 40 | 54.7 | 3,363 | .011 | .013 |
| November | 72 | 72 | 72.0 | 4,284 | .014 | .016 |
| December | 120 | 72 | 85.2 | 5,239 | .017 | .020 |
| The year | 1,220 | 34 | 278 | 200,900 | .055 | .752 |

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction.

## HUMBOLDT RIVER NEAR GOLCONDA, NEV.

This station was established October 24, 1894. It is located 1¼ miles north of the town of Golconda, near the great northern bend of Humboldt River and below the central valley, and is about 12 miles above the mouth of Little Humboldt River.

The channel is straight for 300 feet above and 100 feet below the station. The banks are moderately high, but are liable to overflow at extreme high water. The bed of the stream is of gravel and sand and is somewhat shifting. There is but one channel at all stages.

Measurements prior to 1904 were made from a cable and suspended car. Subsequent measurements have been made from the upper side of a wagon bridge, constructed during the winter of 1903–4, 10 feet above the cable. At low stages, when the current is sluggish, measurements can be made by wading above or below the cable.

The gage was read during 1905 by Charles Shallenberger. A new gage and bench mark were established October 4, 1904, replacing the inclined gage installed November 28, 1902, which was fastened to the left bank by 4 by 4 inch stakes, and the zero of which had the same elevation as the original gage. The new gage is a 4 by 4 inch timber, driven vertically into the river bed, and its upper end is securely fastened to a stringer on the downstream side of the north or right end of the wagon bridge. The bench mark of the old gage was a 4 by 4 inch timber, driven 4 feet north of the cable post on the left bank, at an elevation of 10.75 feet above the zero of the gage. The new bench mark is the head of the lowest rivet of the strut at the northwest corner of the bridge; elevation above zero of new gage, 13.42 feet. The new bench mark is 0.48 foot lower than the old bench mark, so that the new gage zero is 3.15 feet below the old zero.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 303-304; Bull 131, p 52; 140, pp 217-218; WS 16, p 154; 28, p 146; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, pp 288-289.

Discharge: Ann 18, iv, pp 304-305; Bull 131, p 92; 140, p 218; WS 16, p 154; 28, p 153; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, p 289.

Discharge, monthly: Ann 18, iv, p 306; 19, iv, p 427; 20, iv, p 438; 21, iv, p 392; 22, iv, p 401; Bull 140, p 220; WS 75, p 182; 85, p 100; 100, p 157; 133, p 291.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 140, p 219; WS 11, p 74; 16, p 154; 28, p 148; 38, p 329; 51, p 398; 66, p 107; 85, p 99; 100, p 156; 133, p 290.

Hydrographs: Ann 19, iv, p 429; 20, iv, p 439; 21, iv, p 392; 22, iv, p 401.

Rating tables: Ann 19, iv, p 427; WS 28, p 154; 39, p 452; 52, p 520; 66, p 175; 85, p 99; 100, p 156; 133, p 291.

*Discharge measurements of Humboldt River near Golconda, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 25 | W. A. Wolf | 63 | 200 | 0.58 | 6.55 | 116 |
| May 19 | do | 73 | 234 | 1.30 | 6.95 | 302 |
| June 2 | do | 62 | 153 | 1.33 | 5.98 | 203 |
| June 15 | do | 62 | 160 | 1.60 | 6.40 | 257 |
| June 28 | do | 60 | 166 | 1.43 | 6.30 | 238 |
| July 13 | do | 59 | 172 | 1.46 | 6.35 | 252 |
| September 6 | do | | | | 3.10 | [a].5 |

[a] Estimated.

*Estimated monthly discharge of Hobble Creek near Springville, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 24 | 22 | 22.8 | 1,402 |
| February | 28 | 24 | 25.6 | 1,422 |
| March | 30 | 24 | 27.0 | 1,660 |
| April | 78 | 28 | 45.2 | 2,690 |
| May | 132 | 48 | 81.0 | 4,980 |
| June | 99 | 30 | 59.4 | 3,534 |
| July | 26 | 11 | 18.6 | 1,144 |
| August | 107 | 8 | 18.3 | 1,125 |
| September | 26 | 14 | 17.1 | 1,018 |
| October | 16 | 7 | 12.5 | 769 |
| November | 22 | 13 | 16.9 | 1,006 |
| December | 18 | 7 | 14.6 | 898 |
| The year | 132 | 7 | 29.9 | 21,650 |

NOTE.—Open-channel conditions assumed throughout the year. Discharge interpolated for missing gage heights.

## SPANISH FORK BASIN.

### SPANISH FORK NEAR SPANISH FORK, UTAH.

Spanish fork rises in the Wasatch Mountains and flows northwestward into Utah Lake. The area is generally barren, with but little timber or brush. The stream is confined to a steep, narrow canyon, with a very few small openings in which are irrigated farms. The tributaries are all short and many of them are intermittent. The most important are Diamond Fork and Thistle Creek, which enter about 8 and 10 miles, respectively, above the gaging station, and which, like the main stream, occupy steep narrow canyons. The normal flow comes largely from springs, scattered over the entire basin; the flood discharge is direct surface run-off from melting snow.

There are no storage reservoirs on the stream and but little of the flow is diverted above the station. The entire normal flow is, however, diverted at the mouth of the canyon, immediately below the station, and used for the irrigation of lands near Utah Lake.

The station was established May 23, 1900, and reëstablished March 26, 1903. It is located 600 feet above the dam of the East Bench Irrigation Company, 5 miles southeast of Spanish Fork, and 300 feet southwest of the main line of the Rio Grande Western Railway.

Records at this station are of importance in connection with the Strawberry Valley storage reservoir project, under a plan to divert water from that basin into Spanish Fork near its head and carry it to distribution canals below.

The channel is straight for about 150 feet above and below the station. Both banks slope gradually, are covered with small brush, and are sufficiently high to prevent overflow. The bed is composed of loose gravel and sand, and is smooth but somewhat shifting, especially at flood stages. The velocity is high. There is a free flow, the current being uninterrupted by dams or other obstructions.

Discharge measurements are made by means of a cable and car. The cable is graduated with paint, beginning at the right cable post, which is the initial point for soundings.

The gage, which is read daily by Levi Thorp, a section foreman on the Rio Grande Western Railway, consisted originally of a vertical staff located on the right bank of the stream. In April, 1905, it was replaced by a new 6 by 6 inch inclined gage having the same datum. The bench mark is on a limestone rock 29 feet S. 36° E. from the gage, marked with black paint "U. S. G. S."; elevation above gage datum, 7.16 feet; elevation above mean sea level, 4,785 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann.=Annual Report; WS=Water-Supply Paper):

Description: WS 100, p 145; 133, p 271.
Discharge: WS 100, p 145; 133, p 271.
Discharge, monthly: Ann 13, iii, p 97; WS 100, p 147; 133, p 273.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 61.
Gage heights: WS 100, p 146; 133, p 272.
Rating table: WS 100, pp 146-147; 133, pp 272-273.

*Discharge measurements of Spanish Fork near Spanish Fork, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 27 | H. S. Kleinschmidt | 37 | 30 | 2.68 | 1.42 | 79 |
| February 15 | do | 35 | 28 | 2.66 | 1.38 | 74 |
| March 10 | do | 37 | 29 | 2.51 | 1.40 | 72 |
| April 19 | W. G. Swendsen | 39 | 39 | 3.17 | 1.70 | 111 |
| May 11 | W. P. Hardesty | 36 | 44 | 3.50 | 1.90 | 154 |
| May 15 | W. G. Swendsen | 37 | 49 | 4.04 | 2.00 | 200 |
| May 22 | do | 40 | 85 | 4.34 | 2.82 | 369 |
| May 22 | do | 40 | 85 | 4.42 | 2.82 | 376 |
| May 22 | do | 40 | 85 | 4.00 | 2.82 | 360 |
| June 3 | A. B. Larson | 38 | 68 | 4.59 | 2.45 | 314 |
| June 9 | do | 37 | 49 | 3.99 | 2.04 | 195 |
| June 26 | do | 35 | 30 | 2.85 | 1.60 | 86 |
| July 31 | Beers and Schow | 34 | 25 | 2.19 | 1.40 | 54 |
| August 9 | G. S. Schow | 40 | 21 | 1.99 | 1.32 | 43 |
| August 30 | A. B. Larson | 34 | 20 | 2.60 | 1.41 | 52 |
| September 7 | G. S. Schow | 35 | 25 | 2.56 | 1.47 | 64 |
| September 10 | do | 34 | 20 | 2.39 | 1.38 | 49 |
| September 28 | A. B. Larson | 34 | 22 | 2.35 | 1.41 | 52 |
| October 12 | W. D. Beers | 33 | 24 | 2.46 | 1.48 | 59 |

*Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.46 | 1.6 | 1.5 | 2.06 | 2.56 | 1.52 | 1.36 | 1.36 | 1.64 | 1.48 | 1.46 |
| 2 | 1.26 | 1.56 | 1.56 | 1.48 | 2.04 | 2.52 | 1.5 | 1.34 | 1.36 | 1.56 | 1.48 | 1.44 |
| 3 | 1.5 | 1.5 | 1.62 | 1.48 | 2.02 | 2.48 | 1.5 | 1.4 | 1.36 | 1.44 | 1.48 | 1.4 |
| 4 | 1.32 | 1.5 | 1.54 | 1.46 | 1.96 | 2.38 | 1.46 | 1.36 | 1.61 | 1.44 | 1.48 | 1.44 |
| 5 | 1.4 | 1.5 | 1.5 | 1.48 | 1.92 | 2.26 | 1.44 | 1.36 | 1.42 | 1.42 | 1.48 | 1.5 |
| 6 | 1.56 | 4.48 | 1.5 | 1.48 | 1.82 | 2.24 | 1.46 | 1.36 | 1.4 | 1.44 | 1.48 | 1.4 |
| 7 | 1.4 | 1.46 | 1.48 | 1.5 | 1.82 | 2.14 | 1.46 | 1.3 | 1.44 | 1.45 | 1.48 | 1.44 |
| 8 | 1.4 | 1.46 | 1.48 | 1.52 | 1.84 | 2.1 | 1.46 | 1.3 | 1.42 | 1.42 | 1.48 | 1.44 |
| 9 | 1.4 | 1.4 | 1.46 | 1.54 | 1.98 | 2.02 | 1.4 | 1.3 | 1.4 | 1.42 | 1.48 | 1.44 |
| 10 | 1.42 | 1.42 | 1.46 | 1.76 | 1.96 | 2.02 | 1.42 | 1.36 | 1.4 | 1.48 | 1.48 | 1.4 |
| 11 | 1.44 | 1.44 | 1.46 | 1.7 | 1.9 | 2.0 | 1.42 | 1.5 | 1.4 | 1.48 | 1.48 | 1.3 |
| 12 | 1.4 | 1.26 | 1.44 | 1.7 | 1.84 | 1.96 | 1.4 | 1.4 | 1.4 | 1.48 | 1.48 | 1.24 |
| 13 | 1.38 | 1.6 | 1.46 | 1.66 | 2.0 | 1.88 | 1.38 | 1.38 | 1.4 | 1.46 | 1.4 | 1.25 |
| 14 | 1.42 | 1.4 | 1.48 | 1.64 | 2.0 | 1.82 | 1.4 | 1.38 | 1.4 | 1.46 | 1.44 | 1.4 |
| 15 | 1.42 | 1.4 | 1.48 | 1.62 | 2.0 | 1.76 | 1.4 | 1.36 | 1.4 | 1.48 | 1.44 | 1.3 |
| 16 | 1.44 | 1.34 | 1.44 | 1.7 | 2.04 | 1.76 | 1.4 | 1.34 | 1.4 | 1.48 | 1.44 | 1.25 |
| 17 | 1.42 | 1.44 | 1.46 | 1.7 | 2.22 | 1.74 | 1.4 | 1.34 | 1.34 | 1.48 | 1.46 | 1.3 |
| 18 | 1.42 | 1.42 | 1.46 | 1.66 | 2.41 | 1.76 | 1.38 | 1.34 | 1.34 | 1.46 | 1.46 | 1.3 |
| 19 | 1.34 | 1.4 | 1.5 | 1.74 | 2.54 | 1.78 | 1.38 | 1.32 | 1.38 | 1.44 | 1.46 | 1.3 |
| 20 | 1.44 | 1.44 | 1.6 | 1.72 | 2.64 | 1.78 | 1.36 | 1.32 | 1.38 | 1.44 | 1.44 | 1.3 |

*Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 1.44 | 1.48 | 1.6 | 1.72 | 2.74 | 1.78 | 1.34 | 1.32 | 1.36 | 1.44 | 1.44 | 1.4 |
| 22 | 1.44 | 1.48 | 1.52 | 1.7 | 2.84 | 1.74 | 1.36 | 1.3 | 1.36 | 1.48 | 1.5 | 1.35 |
| 23 | 1.46 | 1.46 | 1.5 | 1.74 | 2.94 | 1.72 | 1.34 | 1.3 | 1.36 | 1.48 | 1.5 | 1.4 |
| 24 | 1.44 | 1.48 | 1.5 | 1.76 | 2.84 | 1.66 | 1.34 | 1.32 | 1.34 | 1.48 | 1.5 | 1.4 |
| 25 | 1.46 | 1.48 | 1.5 | 1.78 | 2.74 | 1.6 | 1.34 | 1.66 | 1.44 | 1.48 | 1.46 | 1.4 |
| 26 | 1.42 | 1.48 | 1.48 | 1.86 | 2.8 | 1.6 | 1.34 | 1.42 | 1.48 | 1.48 | 1.46 | 1.4 |
| 27 | 1.36 | 1.46 | 1.5 | 1.92 | 2.74 | 1.58 | 1.34 | 1.46 | 1.5 | 1.48 | 1.5 | 1.4 |
| 28 | 1.38 | 1.5 | 1.5 | 1.98 | 2.78 | 1.58 | 1.34 | 1.48 | 1.46 | 1.48 | 1.46 | 1.5 |
| 29 | 1.44 | ....... | 1.52 | 1.97 | 2.7 | 1.56 | 1.34 | 1.4 | 2.22 | 1.48 | 1.46 | 1.7 |
| 30 | 1.46 | ....... | 1.54 | 2.0 | 2.6 | 1.54 | 1.34 | 1.38 | 1.64 | 1.48 | 1.46 | 1.45 |
| 31 | 1.44 | ....... | 1.46 | ....... | 2.56 | ....... | 1.34 | 1.34 | ....... | 1.5 | ....... | 1.45 |

NOTE.—January 3 and 6 and February 13, backwater caused by ice; open-channel conditions during the remainder of the winter months. Gage February 6 probably in error.

*Daily discharge, in second-feet, of Spanish Fork near Spanish Fork, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 57 | 86 | 112 | 79 | 192 | 336 | 56 | 48 | 45 | 92 | 60 | 61 |
| 2 | 39 | 106 | 104 | 76 | 187 | 329 | 54 | 46 | 45 | 76 | 60 | 59 |
| 3 | 43 | 95 | 115 | 75 | 182 | 322 | 54 | 54 | 45 | 54 | 61 | 53 |
| 4 | 47 | 95 | 100 | 71 | 168 | 292 | 48 | 48 | 89 | 54 | 61 | 59 |
| 5 | 57 | 95 | 92 | 74 | 158 | 258 | 47 | 48 | 53 | 50 | 61 | 69 |
| 6 | 59 | 91 | 92 | 74 | 136 | 252 | 49 | 48 | 50 | 53 | 62 | 53 |
| 7 | 60 | 87 | 88 | 77 | 136 | 224 | 50 | 42 | 59 | 50 | 62 | 59 |
| 8 | 61 | 87 | 88 | 81 | 140 | 212 | 51 | 42 | 53 | 50 | 62 | 59 |
| 9 | 62 | 75 | 84 | 83 | 172 | 190 | 43 | 42 | 52 | 50 | 62 | 59 |
| 10 | 66 | 79 | 83 | 127 | 168 | 188 | 46 | 46 | 52 | 60 | 62 | 53 |
| 11 | 70 | 83 | 82 | 114 | 154 | 180 | 47 | 68 | 52 | 60 | 63 | 41 |
| 12 | 64 | 52 | 78 | 113 | 145 | 168 | 44 | 52 | 52 | 59 | 63 | 35 |
| 13 | 60 | 64 | 81 | 109 | 189 | 147 | 43 | 49 | 52 | 55 | 50 | 36 |
| 14 | 69 | 76 | 85 | 100 | 195 | 132 | 46 | 49 | 52 | 55 | 56 | 54 |
| 15 | 69 | 77 | 84 | 96 | 200 | 118 | 46 | 46 | 52 | 59 | 56 | 42 |
| 16 | 74 | 65 | 76 | 112 | 203 | 116 | 46 | 44 | 52 | 59 | 56 | 36 |
| 17 | 71 | 74 | 80 | 112 | 242 | 110 | 47 | 44 | 44 | 59 | 59 | 42 |
| 18 | 72 | 71 | 79 | 102 | 286 | 112 | 44 | 44 | 44 | 56 | 59 | 42 |
| 19 | 58 | 76 | 86 | 119 | 315 | 115 | 45 | 41 | 48 | 54 | 59 | 42 |
| 20 | 77 | 83 | 105 | 114 | 335 | 113 | 43 | 41 | 48 | 54 | 57 | 42 |
| 21 | 78 | 91 | 105 | 114 | 355 | 111 | 42 | 41 | 45 | 54 | 57 | 55 |
| 22 | 79 | 91 | 89 | 111 | 375 | 102 | 43 | 38 | 45 | 59 | 67 | 48 |
| 23 | 81 | 85 | 84 | 119 | 410 | 96 | 42 | 38 | 45 | 59 | 67 | 55 |
| 24 | 80 | 89 | 84 | 122 | 384 | 81 | 42 | 41 | 43 | 59 | 67 | 55 |
| 25 | 83 | 89 | 83 | 127 | 360 | 68 | 43 | 95 | 55 | 59 | 60 | 56 |
| 26 | 76 | 89 | 79 | 144 | 382 | 67 | 43 | 53 | 62 | 60 | 60 | 56 |
| 27 | 67 | 85 | 82 | 158 | 368 | 64 | 44 | 58 | 66 | 60 | 68 | 56 |
| 28 | 70 | 94 | 82 | 172 | 383 | 65 | 44 | 62 | 58 | 60 | 61 | 74 |
| 29 | 82 | ....... | 85 | 170 | 364 | 62 | 45 | 50 | 228 | 60 | 61 | 114 |
| 30 | 85 | ....... | 88 | 178 | 340 | 58 | 45 | 47 | 92 | 60 | 61 | 65 |
| 31 | 82 | ....... | 72 | ....... | 331 | ....... | 46 | 43 | ....... | 65 | ....... | 65 |

NOTE.—Daily discharge obtained by indirect method for shifting channels. Discharge January 3 and 6 and February 13 reduced on account of backwater from ice. Discharge February 6 interpolated between February 5 and 7 on assumption that gage height of February 6 was in error.

*Estimated monthly discharge of Spanish Fork River near Spanish Fork, Utah, for 1905.*

[Drainage area, 670 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 85 | 39 | 67.7 | 4,163 | 0.101 | 0.116 |
| February | 106 | 52 | 83.2 | 4,621 | .124 | .129 |
| March | 115 | 72 | 88 | 5,411 | .131 | .151 |
| April | 178 | 71 | 111 | 6,605 | .166 | .185 |
| May | 410 | 136 | 257 | 15,800 | .384 | .443 |
| June | 336 | 58 | 156 | 9,283 | .233 | .260 |
| July | 56 | 42 | 46.1 | 2,835 | .069 | .080 |
| August | 95 | 38 | 48.6 | 2,988 | .073 | .084 |
| September | 228 | 43 | 59.3 | 3,529 | .089 | .099 |
| October | 92 | 50 | 58.5 | 3,597 | .087 | .100 |
| November | 68 | 50 | 60.7 | 3,612 | .091 | .102 |
| December | 114 | 35 | 54.7 | 3,363 | .082 | .094 |
| The year | 410 | 35 | 90.9 | 65,810 | .136 | 1.84 |

## SPANISH FORK NEAR LAKE SHORE, UTAH.

This station was established December 10, 1903, at the highway bridge on the road between Spanish Fork and Lake Shore, about 3 miles west of Spanish Fork. In May, 1904, it was reestablished at a point about 800 feet above the bridge.

As the entire normal summer flow is diverted at a point above, the station is maintained only during the spring and winter, the object being the determination of the amount of water discharged by Spanish Fork into Utah Lake.

The channel is straight for about 75 feet above and is slightly curved for 100 feet below the station. Both banks are barren and sufficiently high to prevent overflow. The bed at this point is composed of fine gravel and sand, smooth but continually shifting. The velocity ranges from 2 to 4 feet per second, and the depth from 1 foot to 3 feet. Information in regard to winter conditions are incomplete.

Discharge measurements are made from a cable and car. The cable is marked at 4-foot intervals, beginning at the right cable post, which is the initial point for soundings.

Daily gage readings are made by J. W. Bowen, a farmer. The original gage was a vertical staff driven into the bed of the stream about 10 feet below the bridge. This was abandoned at the beginning of 1905, and readings have since been taken from the new vertical gage located on the right bank near the cable. It consists of a 2 by 4 inch fir post, driven into the bed of the stream and supported at the top by a horizontal piece buried in the bank. The datum is the same as that of the old gage, but simultaneous readings will not agree, as there is considerable fall to the stream between the two gages. The gage is referred to bench marks as follows: (1) A 30-penny nail driven into a log on the west abutment of the bridge, near the northwest corner, 10.5 feet S. 18° 30′ W., from the old gage; elevation above gage datum, 11.68 feet. (2) A 20-penny nail driven into the north side of a cedar fence post, 91 feet, S. 85° 30′ E., from the gage; elevation above gage datum, 21.95 feet. (3) A United States Geological Survey standard metallic post set 197 feet S. 21° 45′ E. from the old gage; elevation above gage datum, 21.76 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 133, p 274.
Discharge: 100, p. 224; 133, p. 275.
Discharge, monthly: 133, p. 276.
Gage heights: 133, p 275.
Rating table: 133, p 276.

*Discharge measurements of Spanish Fork near Lake Shore, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 27 | H. S. Kleinschmidt | 30 | 26 | 2.57 | 4.61 | 66 |
| February 15 | do | 26 | 21 | 2.31 | 4.37 | 49 |
| March 10 | do | 28 | 18 | 2.27 | 4.12 | 42 |
| April 6 | W. G. Swendsen | 28 | 23 | 2.41 | 4.35 | 66 |
| April 20 | do | 32 | 36 | 2.67 | 4.78 | 96 |
| May 4[a] | W. P. Hardesty | 6 | 6.7 | 2.84 | 3.85 | 19 |
| May 22 | W. G. Swendsen | 24 | 15 | 2.55 | 4.05 | 38 |
| December 4 | do | 28 | 18 | 2.16 | 4.12 | 38 |

[a] 30 feet below regular station.

*Daily gage height, in feet, of Spanish Fork near Lake Shore, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. | Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.6 | 4.67 | 4.52 | 4.5 | 4.75 | ...... | 4.0 | 17 | 4.62 | 4.6 | 4.08 | 4.9 | 3.4 | ...... | 4.3 |
| 2 | 4.1 | 4.97 | 4.58 | 4.35 | 4.3 | ...... | 4.2 | 18 | 4.6 | 4.6 | 4.1 | 5.0 | 4.0 | ...... | 4.3 |
| 3 | 4.2 | 4.85 | 4.52 | 4.33 | 4.2 | ...... | 4.2 | 19 | 4.5 | 4.59 | 4.15 | 4.9 | 4.02 | ...... | 4.1 |
| 4 | 4.2 | 4.8 | 4.5 | 4.3 | 3.85 | ...... | 4.2 | 20 | 4.6 | 4.58 | 4.3 | 4.85 | 3.7 | ...... | 4.1 |
| 5 | 4.1 | 4.73 | 4.55 | 4.31 | 3.6 | ...... | 4.18 | 21 | 4.6 | 4.6 | 4.25 | 4.72 | 3.7 | ...... | 4.1 |
| 6 | 4.4 | 4.7 | 4.53 | 4.35 | 3.48 | ...... | 4.1 | 22 | 4.63 | 4.61 | 4.3 | 4.71 | 3.9 | ...... | 4.1 |
| 7 | 4.2 | 4.68 | 3.9 | 4.48 | 3.43 | ...... | 4.05 | 23 | 4.7 | 4.55 | 4.3 | 4.63 | 4.3 | ...... | 4.2 |
| 8 | 4.45 | 4.61 | 4.1 | 4.58 | 3.42 | ...... | 4.0 | 24 | 4.63 | 4.55 | 4.2 | 4.73 | 4.03 | ...... | 4.2 |
| 9 | 4.45 | 4.5 | 4.11 | 4.68 | 3.43 | ...... | ...... | 25 | 4.62 | 4.55 | 4.2 | 4.65 | 3.5 | ...... | 4.2 |
| 10 | 4.2 | 4.58 | 4.15 | 5.1 | 3.4 | ...... | 4.0 | 26 | 4.61 | 4.58 | 4.0 | 4.68 | 3.55 | ...... | 4.3 |
| 11 | 4.62 | 4.6 | 4.05 | 4.98 | 3.42 | ...... | 4.1 | 27 | 4.6 | 4.58 | 4.15 | 4.79 | 3.5 | ...... | 4.3 |
| 12 | 4.7 | 4.2 | 4.1 | 4.88 | 3.43 | ...... | 4.2 | 28 | 4.59 | 4.51 | 4.1 | 4.82 | 3.53 | ...... | 4.2 |
| 13 | 4.6 | 4.1 | 4.12 | 4.8 | 3.4 | ...... | 4.2 | 29 | 4.58 | ...... | 4.1 | 4.8 | 3.4 | ...... | 4.3 |
| 14 | 4.8 | 4.39 | 4.2 | 4.85 | 3.38 | ...... | 4.3 | 30 | 4.6 | ...... | 4.12 | 4.72 | 3.0 | 4.0 | 4.25 |
| 15 | 4.6 | 4.38 | 4.15 | 4.88 | 3.38 | ...... | 4.3 | 31 | 4.61 | ...... | 4.11 | ...... | 3.0 | ...... | ...... |
| 16 | 4.6 | 4.52 | 4.1 | 4.9 | 3.38 | ...... | 4.1 | | | | | | | | |

*Daily discharge, in second-feet, of Spanish Fork near Lake Shore, Utah., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. | Day. | Jan. | Feb. | Mar. | Apr. | May. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 53.0 | 71.0 | 67.0 | 77.0 | 83.0 | ...... | 31.5 | 17 | 62.0 | 67.0 | 41.5 | 108.0 | 7.5 | ...... | 51.5 |
| 2 | 22.5 | 95.5 | 71.5 | 65.0 | 46.0 | ...... | 44.5 | 18 | 61.0 | 67.5 | 43.0 | 116.0 | 33.5 | ...... | 51.5 |
| 3 | 28.0 | 85.5 | 68.0 | 63.5 | 38.2 | ...... | 44.5 | 19 | 53.0 | 67.0 | 46.5 | 106.0 | 35.0 | ...... | 39.0 |
| 4 | 29.5 | 81.2 | 67.0 | 61.0 | 19.0 | .... | 38.5 | 20 | 61.0 | 67.0 | 58.0 | 96.0 | 18.5 | ...... | 38.0 |
| 5 | 23.0 | 76.0 | 72.0 | 62.5 | 10.3 | ...... | 43.5 | 21 | 62.0 | 69.0 | 54.0 | 89.5 | 19.3 | ...... | 38.0 |
| 6 | 41.0 | 73.0 | 71.5 | 66.0 | 7.0 | ...... | 38.0 | 22 | 65.0 | 70.5 | 58.0 | 88.0 | 28.5 | ...... | 38.0 |
| 7 | 29.5 | 72.2 | 27.5 | 76.0 | 6.5 | ...... | 34.7 | 23 | 71.0 | 66.0 | 58.0 | 80.0 | 54.5 | ...... | 44.5 |
| 8 | 45.5 | 66.0 | 39.0 | 83.5 | 6.0 | ...... | 32.0 | 24 | 65.5 | 66.5 | 51.0 | 88.0 | 36.5 | ...... | 44.5 |
| 9 | 46.0 | 58.0 | 41.5 | 92.0 | 6.5 | ...... | 32.0 | 25 | 64.5 | 67.5 | 51.5 | 80.5 | 11.2 | ...... | 44.5 |
| 10 | 30.0 | 64.5 | 42.0 | 129.0 | 6.0 | ...... | 32.0 | 26 | 65.0 | 70.5 | 38.0 | 82.0 | 13.0 | ...... | 51.5 |
| 11 | 58.5 | 66.0 | 37.5 | 117.5 | 6.5 | ...... | 38.0 | 27 | 66.0 | 71.5 | 48.0 | 90.0 | 11.0 | ...... | 51.5 |
| 12 | 66.0 | 36.0 | 41.0 | 108.0 | 7.0 | ...... | 44.5 | 28 | 64.5 | 65.5 | 45.0 | 91.0 | 12.0 | ...... | 44.5 |
| 13 | 58.5 | 30.5 | 42.5 | 100.0 | 6.5 | ...... | 44.5 | 29 | 63.5 | ...... | 45.2 | 89.0 | 7.5 | 0.0 | 51.5 |
| 14 | 75.0 | 50.0 | 48.5 | 104.0 | 6.2 | ...... | 51.5 | 30 | 65.0 | ...... | 46.5 | 80.0 | 0.0 | 32.5 | 48.0 |
| 15 | 59.0 | 49.0 | 45.5 | 106.5 | 6.5 | ...... | 51.5 | 31 | 65.5 | ...... | 46.0 | ...... | 0.0 | ...... | 48.0 |
| 16 | 60.0 | 59.5 | 42.0 | 108.0 | 6.8 | ...... | 38.5 | | | | | | | | |

NOTE.—Total flow of river diverted for irrigation May 30 to November 29. Daily discharge obtained by indirect method for shifting channels. Discharge interpolated December 9 and 31.

*Estimated monthly discharge of Spanish Fork near Lake Shore, Utah, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 75 | 22.5 | 54.2 | 3,333 |
| February | 95.5 | 30.5 | 66.0 | 3,665 |
| March | 72 | 27.5 | 50.1 | 3,080 |
| April | 129 | 61 | 90.1 | 5,361 |
| May | 83 | 0 | 17.9 | 1,101 |
| June | 0 | 0 | 0 | 0 |
| July | 0 | 0 | 0 | 0 |
| August | 0 | 0 | 0 | 0 |
| September | 0 | 0 | 0 | 0 |
| October | 0 | 0 | 0 | 0 |
| November | 32.5 | 0 | 1.08 | 64 |
| December | 51.5 | 31.5 | 42.7 | 2,626 |
| The year | 129 | 0 | 26.8 | 19,230 |

## SEVIER RIVER BASIN.

### SEVIER RIVER NEAR GUNNISON, UTAH.

Sevier River rises in the northwestern part of Kane County, in southern Utah, flows northeastward to a point near Gunnison, northwestward nearly to Leamington, and then turns sharply to the southwest and discharges into Sevier Lake.

Tributary streams are few, San Pitch River and Salina Creek being the most important. The San Pitch joins the main stream about 3 miles above the gaging station, but since its flow is used for irrigation and is completely controlled by storage reservoirs, it furnishes little of the supply. Salina Creek, which enters about 15 miles above the station, is subject to rapid run-off and during flood seasons carries an immense amount of sediment.

There is considerable irrigation from the Sevier above Gunnison, and a few small storage reservoirs control the flood discharge.

The station was established June 29, 1900. It is located at the wagon bridge over the Sevier about 4 miles west of Gunnison, on the road to Westview precinct.

The channel is straight for about 300 feet above and below the station, with banks sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel and is smooth and apparently permanent. The current is sluggish at low water, but at ordinary stages ranges from 2 to 3 feet per second. At the high-water section the velocity is greatest at the right side, decreasing somewhat uniformly toward the left, where it is low. Floating ice during the winter season may make records at certain stages impossible. There is a free flow at the low-water but not at the high-water section.

During ordinary stages discharge measurements are made from the upstream side of the bridge, the floor of which is marked at 5-foot intervals, beginning at the bridge pile to which the gage is attached, this being the initial point for soundings. At extreme low water the velocity at this point is too low for favorable results, and measurements are made by wading at a point about 75 feet below the bridge, marked by a 2 by 4 inch post on each bank. The initial point for soundings at this section is the post on the left bank.

The gage is read daily by L. H. Erickson, a farmer. The original gage is a 1 by 4 inch piece of redwood nailed vertically to a bridge pier on the right bank on the upstream side of the bridge. In January, 1905, a new 6 by 6 inch inclined gage was established at a point about 25 feet below the old one. It is fastened to double posts set in the bank. Both gages have the same datum and are referred to bench marks as follows: (1) A large spike driven into the side of a cedar post 46 feet S. 74° E. from the gage; elevation, 8.55 feet. (2) A nail in the top of railing post at the northeast corner of the bridge 13 feet north of the gage; elevation, 13.18 feet. (3) A United States Geological Survey standard iron post set in the ground 153 feet S. 84° 30′ E. from the old gage; elevation, 10.10 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS = Water-Supply Paper):

Description: WS 51, p 425; 66, p 126; 85, p 88; 100, pp 147-148; 133, pp 277-278.
Discharge: WS 51, p 425; 66, p 126; 85, p 88; 100, p 148; 133, p 278.
Discharge, monthly: Ann 22, iv, p 420; WS 75 p 197; 85, p 90; 100, p 149; 133, p 280.
Gage heights: WS 51, p 426; 66, p 126; 85, p 89; 100, pp 148-149; 133, p 279.
Hydrograph: Ann 22, iv, p 420.
Rating tables: WS 52, p 521; 66, p 176; 85, p 89; 100, p 148; 133, p 280.

*Discharge measurements of Sevier River near Gunnison, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 19[a] | C. Tanner | 50 | 123 | 2.60 | 2.25 | 320 |
| Febrary 7[a] | do | 50 | 120 | 2.50 | 2.20 | 301 |
| April 23 | W. G. Swendsen | 36 | 35 | 1.47 | .80 | 52 |
| June 19 | C. S. Jarvis | 35 | 32 | 1.51 | .76 | 49 |
| July 1 | do | 30 | 22 | .89 | .42 | 20 |
| August 11 | do | 29 | 25 | 1.17 | .53 | 30 |

[a] Measured at bridge.

*Daily gage height, in feet, of Sevier River near Gunnison, Utah, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | ...... | 2.4 | 1.1 | .72 | 2.8 | .4 | .5 | .7 | .86 | ...... | 1.14 |
| 2 | ...... | ...... | 2.4 | 1.1 | .7 | 2.86 | .4 | .5 | .7 | 1.0 | 1.16 | 1.3 |
| 3 | ...... | ...... | 2.44 | 1.1 | .7 | 2.96 | .4 | .5 | .9 | 1.0 | 1.16 | 1.2 |
| 4 | ...... | ...... | 2.34 | 1.1 | .72 | 2.7 | .4 | .5 | .86 | 1.02 | 1.16 | 1.2 |
| 5 | ...... | ...... | 2.28 | 1.14 | .7 | 2.46 | ...... | .5 | .7 | 1.06 | 1.14 | 1.14 |
| 6 | ...... | 2.3 | 2.1 | 1.1 | .7 | 2.38 | .4 | .5 | .7 | 1.06 | 1.14 | 1.16 |
| 7 | ...... | 2.2 | 1.88 | 1.1 | .7 | 2.36 | .4 | .54 | .74 | 1.08 | 1.16 | 1.16 |
| 8 | ...... | 2.2 | 1.7 | 1.12 | .76 | 2.24 | .42 | .54 | .74 | 1.1 | 1.16 | 1.18 |
| 9 | ...... | 2.16 | 1.76 | ...... | .78 | 2.2 | .4 | .54 | .76 | 1.1 | 1.14 | 1.16 |
| 10 | ...... | 2.22 | 1.96 | 1.12 | .84 | 1.76 | .4 | .54 | .9 | 1.14 | 1.14 | ...... |
| 11 | ...... | 2.18 | 1.9 | 1.12 | .96 | 1.76 | .42 | .54 | .86 | 1.16 | 1.12 | 1.16 |
| 12 | ...... | 2.26 | 1.88 | 1.06 | .98 | 1.56 | .4 | .56 | .7 | 1.18 | 1.12 | 1.18 |
| 13 | ...... | 2.6 | 1.84 | 1.0 | 1.0 | 1.2 | .4 | .56 | .7 | 1.18 | 1.12 | 1.2 |
| 14 | ...... | 3.1 | 1.8 | .9 | 1.04 | 1.1 | .4 | .56 | .72 | 1.2 | 1.12 | 1.2 |
| 15 | ...... | 2.0 | 1.76 | .9 | 1.24 | .9 | .4 | .56 | .7 | 1.18 | 1.14 | 1.18 |
| 16 | ...... | 2.0 | ...... | .86 | 1.56 | .9 | .42 | .56 | .7 | 1.14 | 1.12 | ...... |
| 17 | ...... | 2.02 | 1.64 | .84 | 1.58 | .8 | .42 | .56 | .7 | 1.1 | 1.12 | ...... |
| 18 | 2.0 | 2.0 | 1.6 | .78 | 1.6 | .82 | .4 | .56 | .7 | 1.1 | 1.1 | ...... |
| 19 | 2.25 | 2.0 | 1.58 | .8 | 1.66 | .82 | .4 | .56 | .7 | 1.1 | 1.1 | ...... |
| 20 | 2.2 | 2.0 | 1.62 | .8 | 1.7 | .76 | .4 | .58 | .7 | 1.1 | 1.1 | ...... |
| 21 | 2.2 | 2.12 | 1.56 | .78 | 1.74 | .7 | ...... | .58 | .7 | 1.12 | 1.1 | ...... |
| 22 | 2.2 | 2.22 | ...... | .78 | 1.76 | .56 | .4 | .58 | .7 | 1.16 | 1.1 | ...... |
| 23 | 2.06 | 2.26 | 1.5 | ...... | 1.94 | .52 | .4 | .6 | .72 | 1.16 | 1.12 | ...... |
| 24 | 2.2 | 2.38 | 1.4 | .9 | 2.44 | .5 | .4 | .6 | .74 | 1.16 | 1.12 | ...... |
| 25 | 2.22 | 2.38 | 1.4 | .82 | 3.25 | .46 | .4 | .6 | .74 | 1.16 | 1.12 | ...... |
| 26 | 2.24 | 2.38 | 1.34 | .78 | 3.23 | .44 | .44 | .86 | .78 | 1.14 | 1.12 | ...... |
| 27 | 2.26 | 2.3 | 1.24 | .78 | 3.3 | .42 | .44 | .96 | .78 | 1.14 | 1.14 | ...... |
| 28 | 2.22 | 2.3 | ...... | .74 | 3.32 | .4 | .52 | .8 | .8 | 1.16 | 1.14 | ...... |
| 29 | 2.22 | ...... | 1.16 | .7 | 3.22 | .4 | .52 | .74 | .82 | 1.16 | 1.14 | ...... |
| 30 | 2.26 | ...... | 1.1 | .7 | 3.24 | .4 | .5 | .7 | .86 | 1.16 | 1.14 | ...... |
| 31 | 2.24 | ...... | 1.14 | ...... | 2.6 | ...... | .5 | .7 | ...... | 1.18 | ...... | ...... |

**Note.**—River frozen January 1-17 and December 16-31.

*Station rating table for Sevier River near Gunnison, Utah, from January 18 to December 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.40 | 17 | 1.20 | 101 | 2.00 | 254 | 2.80 | 474 |
| 0.50 | 24 | 1.30 | 116 | 2.10 | 278 | 2.90 | 506 |
| 0.60 | 32 | 1.40 | 132 | 2.20 | 303 | 3.00 | 539 |
| 0.70 | 41 | 1.50 | 149 | 2.30 | 329 | 3.10 | 573 |
| 0.80 | 51 | 1.60 | 168 | 2.40 | 356 | 3.20 | 608 |
| 0.90 | 62 | 1.70 | 188 | 2.50 | 384 | 3.30 | 644 |
| 1.00 | 74 | 1.80 | 209 | 2.60 | 413 | 3.40 | 681 |
| 1.10 | 87 | 1.90 | 231 | 2.70 | 443 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined between gage heights 0.4 foot and 1 foot and fairly well defined above 1 foot.

*Estimated monthly discharge of Sevier River near Gunnison, Utah, for 1905.*

[Drainage area, 3,986 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 18-31 | 319 | 254 | 303 | 8,414 | 0.076 | 0.040 |
| February | 573 | 254 | 318 | 17,660 | .080 | .083 |
| March | 367 | 87 | 199 | 12,240 | .050 | .058 |
| April | 92 | 41 | 67.0 | 3,987 | .017 | .019 |
| May | 651 | 41 | 222 | 13,650 | .056 | .065 |
| June | 525 | 17 | 164 | 9,759 | .041 | .046 |
| July | 26 | 17 | 18.4 | 1,131 | .0046 | .0053 |
| August | 69 | 24 | 32.3 | 1,986 | .0081 | .0093 |
| September | 62 | 41 | 46.2 | 2,749 | .012 | .013 |
| October | 101 | 58 | 89.3 | 5,491 | .022 | .025 |
| November | 95 | 87 | 91.4 | 5,439 | .023 | .026 |
| December 1-15 | 116 | 93 | 98.3 | 2,925 | .025 | .014 |
| The period | | | | 85,430 | | |

NOTE.—Discharge interpolated on days when gage heights were missing.

## SAN PITCH RIVER NEAR GUNNISON, UTAH.

San Pitch River, which enters Sevier River from the north, flows throughout its course in a well-defined channel with no overflow. Over the lower portions of the area evaporation and seepage doubtless exceed inflow to the stream. There are small tracts of irrigated land at various points along the river, and a storage reservoir about 10 miles above the gaging station completely controls the flow. The tributaries are few and mostly intermittent. Manti Creek, which enters at a point about 11 miles above the station, drains a barren area and is subject to rapid run-off. Its discharge may vary from 4 to 150 second-feet, but it enters above the reservoir dam and is thus completely controlled before reaching the gaging station.

The station was established June 30, 1900. It is located 4 miles northeast of Gunnison about one-eighth mile west of the Rio Grande Western Railway, west of the second farmhouse along the railroad track north of Gunnison station.

The channel is straight for about 100 feet above and is slightly curved below the station. Both banks slope gradually and are sufficiently high to prevent overflow. The bed of the stream is composed of sand and gravel, and is smooth and apparently permanent. The velocity is high. Information in regard to winter conditions is indefinite.

Discharge measurements are made by wading at a point near the gage, where a tagged wire is stretched. The initial point for soundings is the west side of the supporting post on the left bank.

The gage, which is read daily by Oliver Peterson, is a vertical staff driven into the stream bed. It is referred to bench marks as follows: (1) The top of a cedar post set about 45.5 feet west from the gage; elevation, 5.96 feet. (2) Top of nail driven into top of stake set about 150 feet S. 84° E. from the initial point; elevation, 10.36 feet. Elevations are above datum of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge: WS 51, p 425; 66, p 125; 85, p 94; 100, p 150; 133, p 281.
Discharge, monthly: Ann 22, iv, p 419; WS 75, p 196; 85, p 96; 100, p 152; 133, p 283.
Gage heights: WS 51, p 425; 66, p 125; 85, p 95; 100, p 151; 133, p 282.
Hydrograph: Ann 22, iv, p 419.
Rating tables: WS 52, p 521; 66, p 176; 85, p 95; 100, p 151; 133, p 282.

*Discharge measurements of San Pitch River near Gunnison, Utah, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 18 | C. Tanner | 23 | 20 | 0.60 | 1.76 | 12 |
| June 19 | C. S. Jarvis | 31 | 40 | 2.92 | 2.46 | 116 |
| July 1 | do | 29 | 36 | 2.63 | 2.40 | 96 |
| August 12 | do | 29 | 40 | 2.88 | 2.46 | 114 |

*Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.78 | 1.78 | 1.8 | 1.76 | 2.44 | 3.0 | 2.44 | 2.54 | 2.0 | 2.08 | 1.96 | 1.9 |
| 2 | 1.78 | 1.9 | 1.78 | 1.78 | 2.4 | 2.9 | 2.56 | 2.5 | 2.06 | 2.04 | 1.96 | 1.9 |
| 3 | 1.78 | 1.9 | 1.78 | 1.78 | 2.3 | 2.76 | 2.54 | 2.52 | 2.04 | 2.04 | 2.0 | 1.9 |
| 4 | 1.78 | 1.9 | 1.76 | 1.78 | 2.3 | 2.8 | 2.54 | 2.5 | 2.06 | 2.02 | 2.0 | 1.9 |
| 5 | 1.8 | 1.88 | 1.76 | 1.78 | 2.3 | 3.1 | 2.5 | 2.5 | 2.08 | 2.02 | 1.98 | 1.9 |
| 6 | 1.8 | 1.88 | 1.76 | 1.78 | 2.36 | 2.82 | 2.58 | 2.5 | 2.08 | 2.02 | 1.96 | 1.92 |
| 7 | 1.8 | 1.86 | 1.74 | 1.8 | 2.3 | 2.88 | 2.6 | 2.5 | 2.02 | 2.0 | 1.96 | 1.9 |
| 8 | 1.78 | 1.84 | 1.7 | 1.8 | 2.32 | 2.9 | 2.68 | 2.5 | 2.04 | 2.0 | 1.96 | 1.88 |
| 9 | 1.78 | 1.8 | 1.7 | 1.8 | 2.5 | 2.88 | 2.66 | 2.5 | 2.02 | 2.0 | 1.98 | 1.88 |
| 10 | 1.78 | 1.74 | 1.68 | 1.84 | 2.5 | 2.86 | 2.64 | 2.5 | 2.02 | 2.0 | 1.96 | 1.88 |
| 11 | 1.8 | 1.74 | 1.68 | 1.8 | 2.5 | 3.0 | 2.66 | 2.5 | 2.04 | 1.94 | 1.92 | 1.88 |
| 12 | 1.8 | 1.72 | 1.7 | 1.8 | 2.5 | 3.14 | 2.64 | 2.56 | 2.02 | 1.94 | 1.92 | 1.88 |
| 13 | 1.73 | 1.7 | 1.72 | 1.8 | 2.52 | 2.88 | 2.64 | 2.46 | 2.0 | 1.94 | 1.92 | 1.9 |
| 14 | 1.78 | 1.7 | 1.73 | 1.8 | 2.6 | 2.9 | 2.6 | 2.44 | 2.06 | 1.94 | 1.92 | 1.9 |
| 15 | 1.76 | 1.7 | 1.78 | 1.8 | 2.6 | 2.88 | 2.64 | 2.44 | 2.06 | 1.94 | 1.92 | 1.9 |
| 16 | 1.78 | 1.68 | 1.78 | 1.8 | 2.78 | 2.8 | 2.64 | 2.46 | 2.04 | 1.92 | 1.92 | 1.9 |
| 17 | 1.78 | 1.68 | 1.78 | 1.82 | 2.74 | 2.7 | 2.6 | 2.42 | 2.03 | 1.94 | 1.92 | 1.92 |
| 18 | 1.76 | 1.68 | 1.78 | 1.84 | 2.52 | 2.78 | 2.6 | 2.4 | 2.02 | 1.94 | 1.94 | 1.92 |
| 19 | 1.78 | 1.68 | 1.78 | 1.84 | 2.8 | 2.6 | 2.6 | 2.36 | 2.02 | 1.94 | 1.94 | 1.94 |
| 20 | 1.76 | 1.68 | 1.8 | 1.84 | 2.34 | 2.52 | 2.6 | 2.36 | 2.02 | 1.96 | 1.96 | 1.96 |

*Daily gage height, in feet, of San Pitch River near Gunnison, Utah, for 1905*—Continued.

| Daily. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 1.74 | 1.68 | 1.8 | 1.84 | 2.54 | 2.4 | 2.6 | 2.36 | 2.02 | 1.96 | 2.0 | 1.96 |
| 22 | 1.74 | 1.78 | 1.8 | 1.8 | 3.24 | 2.5 | 2.6 | 2.36 | 2.02 | 1.96 | 2.0 | 1.96 |
| 23 | 1.74 | 1.72 | 1.78 | 1.82 | 2.8 | 2.42 | 2.58 | 2.36 | 2.02 | 1.96 | 1.88 | 1.96 |
| 24 | 1.74 | 1.74 | 1.78 | 1.88 | 2.78 | 2.44 | 2.54 | 2.36 | 2.0 | 1.96 | 1.88 | 1.9 |
| 25 | 1.74 | 1.78 | 1.78 | 1.8 | 2.7 | 2.38 | 2.54 | 2.36 | 2.0 | 1.96 | 1.88 | 1.86 |
| 26 | 1.74 | 1.78 | 1.66 | 1.9 | 2.6 | 2.34 | 2.54 | 2.3 | 2.0 | 1.96 | 1.9 | 1.86 |
| 27 | 1.74 | 1.78 | 1.66 | 2.0 | 2.5 | 2.42 | 2.54 | 2.24 | 2.0 | 1.96 | 1.92 | 1.86 |
| 28 | 1.76 | 1.8 | 1.68 | 2.34 | 2.6 | 2.4 | 2.54 | 2.22 | 1.96 | 1.96 | 1.9 | 1.86 |
| 29 | 1.74 | ....... | 1.66 | 2.34 | 2.4 | 2.42 | 2.56 | 4.15 | 2.3 | 1.96 | 1.9 | 1.86 |
| 30 | 1.74 | ....... | 1.68 | 2.36 | 2.32 | 2.42 | 2.56 | 2.36 | 2.08 | 1.96 | 1.9 | 1.86 |
| 31 | 1.74 | ....... | 1.73 | ....... | 2.6 | ....... | 2.56 | 2.2 | ....... | 1.96 | ....... | 1.86 |

*Station rating table for San Pitch River near Gunnison, Utah, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 10 | 2.10 | 49 | 2.50 | 123 | 2.90 | 227 |
| 1.80 | 15 | 2.20 | 64 | 2.60 | 146 | 3.00 | 258 |
| 1.90 | 24 | 2.30 | 82 | 2.70 | 171 | 3.10 | 290 |
| 2.00 | 35 | 2.40 | 102 | 2.80 | 198 | 3.20 | 324 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is well defined between gage heights 1.65 feet and 2.5 feet.

*Estimated monthly discharge of San Pitch River near Gunnison, Utah, for 1905.*

[Drainage area, 836 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 15 | 11 | 13.3 | 818 | 0.016 | 0.018 |
| February | 24 | 9 | 14.1 | 783 | .017 | .018 |
| March | 15 | 8 | 12.1 | 744 | .014 | .016 |
| April | 94 | 13 | 24.2 | 1,440 | .029 | .032 |
| May | 338 | 82 | 136 | 8,362 | .163 | .188 |
| June | 304 | 90 | 179 | 10,650 | .214 | .239 |
| July | 166 | 110 | 143 | 8,793 | .171 | .197 |
| August | 720 | 64 | 126 | 7,747 | .151 | .174 |
| September | 82 | 30 | 40.5 | 2,410 | .048 | .054 |
| October | 46 | 26 | 32.0 | 1,968 | .038 | .044 |
| November | 35 | 22 | 28.1 | 1,672 | .034 | .038 |
| December | 30 | 20 | 23.9 | 1,470 | .029 | .033 |
| The year | 338 | 8 | 64.3 | 46,860 | .077 | 1.05 |

NOTE.—Open-channel curve assumed to apply throughout the year as the stream is known to freeze but slightly at this station.

## HUMBOLDT SINK DRAINAGE.

The only stream of importance draining into Humboldt Sink is Humboldt River, the basin of which is described below.

## HUMBOLDT RIVER BASIN.

### DESCRIPTION OF BASIN.

Humboldt River rises in the extreme northeastern part of Nevada, flows west and southwest across the structural features of the country, and enters Humboldt Lake, whence its waters find their way into Humboldt Sink. The tributaries follow the general direction of the mountain ranges and flow either to the north or to the south. During low stages the water of the river is almost wholly diverted, and for the future development of the country recourse must be had to the construction of storage reservoirs.

Of the tributaries, North Fork enters the stream west of Peko, Nev., and South Fork about 10 miles below Elko. Pine Creek comes in from the south near Palisade, Nev. Marys River is one of the headwater branches.

### NORTH FORK OF HUMBOLDT RIVER NEAR ELBURZ, NEV.

This station was established October 10, 1902. It is located about one-fourth mile above the junction of North Fork with the main River and 150 feet below the Southern Pacific Railroad bridge. It is 2 miles west of the Southern Pacific Railroad station at Elburz. The nearest post-office is Halleck, Nev.

The channel is straight for 150 feet above and below the station. Both banks are high, but the left will overflow at extreme flood stages. The bed of the stream is composed of gravel and silt and changes slightly. There is but one channel at all stages, and the current is sluggish.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by A. R. Blevins, is an inclined 4 by 4 inch timber fastened to the left bank just above the cable. The bench mark is a 4 by 4 inch timber driven into the ground on the left bank 20 feet upstream from the gage; elevation above zero of gage, 6.99 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 163; 133, p 283.
Discharge: 100, p 164; 133, p 284.
Discharge, monthly: 133, p 285.
Gage heights: 100, p 164; 133, p 284.
Rating table: 133, p 285.

*Discharge measurements of North Fork of Humboldt River near Elburz, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 27 | W. A. Wolf | 37 | 26 | 1.13 | 3.30 | 29.5 |
| May 20 | do | 37 | 27 | 1.18 | 3.35 | 32 |
| June 4 | do | 37 | 32 | 1.25 | 3.50 | 40 |
| July 14 | do | | | | 2.80 | [a] 1 |

[a] Discharge estimated.

*Daily gage height, in feet, of North Fork of Humboldt River near Elburz, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.6 | 3.5 | 3.4 | 3.5 | 3.4 | 3.55 | 2.85 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 2 | 3.6 | 3.5 | 3.4 | 3.5 | 3.5 | 3.55 | 2.85 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 3 | 3.6 | 3.45 | 3.45 | 3.45 | 3.55 | 3.5 | 2.8 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 4 | 3.6 | 3.4 | 3.45 | 3.45 | 3.55 | 3.55 | 2.8 | 2.2 | 2.55 | 2.6 | 3.3 | 3.0 |
| 5 | 3.6 | 3.35 | 3.5 | 3.4 | 3.6 | 3.5 | 2.8 | 2.2 | 2.55 | 2.6 | 3.2 | 3.0 |
| 6 | 3.55 | 3.35 | 3.5 | 3.35 | 3.6 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.1 | 3.0 |
| 7 | 3.55 | 3.35 | 3.5 | 3.35 | 3.6 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.0 | 3.0 |
| 8 | 3.6 | 3.3 | 3.5 | 3.3 | 3.65 | 3.5 | 2.8 | 2.15 | 2.55 | 2.6 | 3.0 | 3.0 |
| 9 | 3.6 | 3.25 | 3.5 | 3.3 | 3.7 | 3.5 | 2.85 | 2.15 | 2.55 | 2.6 | 2.9 | 3.0 |
| 10 | 3.55 | 3.2 | 3.5 | 3.3 | 3.65 | 3.45 | 2.85 | 2.15 | 2.55 | 2.6 | 2.9 | 3.0 |
| 11 | 3.55 | 3.15 | 3.5 | 3.3 | 3.6 | 3.4 | 2.85 | 2.15 | 2.5 | 2.6 | 3.0 | 3.0 |
| 12 | 3.55 | 3.3 | 3.4 | 3.3 | 3.65 | 3.35 | 2.85 | 2.15 | 2.5 | 2.6 | 3.0 | 3.0 |
| 13 | 3.55 | 3.35 | 3.4 | 3.25 | 3.7 | 3.3 | 2.8 | 2.15 | 2.5 | 2.6 | 2.9 | 3.0 |
| 14 | 3.55 | 3.4 | 3.4 | 3.25 | 3.6 | 3.3 | 2.8 | 2.15 | 2.5 | 2.6 | 2.9 | 3.0 |
| 15 | 3.6 | 3.4 | 3.4 | 3.2 | 3.5 | 3.35 | 2.8 | 2.15 | 2.5 | 2.6 | 2.8 | 3.0 |
| 16 | 3.6 | 3.4 | 3.45 | 3.25 | 3.5 | 3.4 | 2.75 | 2.15 | 2.5 | 2.6 | 2.8 | 3.0 |
| 17 | 3.6 | 3.35 | 3.45 | 3.25 | 3.45 | 3.4 | 2.75 | 2.15 | 2.5 | 2.6 | 2.7 | 3.1 |
| 18 | 3.6 | 3.3 | 3.5 | 3.3 | 3.4 | 3.3 | 2.75 | 2.15 | 2.5 | 2.6 | 2.7 | 3.1 |
| 19 | 3.6 | 3.3 | 3.5 | 3.3 | 3.35 | 3.25 | 2.75 | 2.15 | 2.55 | 2.6 | 2.7 | 3.1 |
| 20 | 3.8 | 3.3 | 3.5 | 3.3 | 3.35 | 3.2 | 2.7 | 2.15 | 2.55 | 2.6 | 2.7 | 3.2 |
| 21 | 3.8 | 3.3 | 3.5 | 3.35 | 3.3 | 3.15 | 2.7 | 2.15 | 2.6 | 2.6 | 2.7 | 3.2 |
| 22 | 3.8 | 3.3 | 3.5 | 3.35 | 3.35 | 3.15 | 2.7 | 2.2 | 2.6 | 2.6 | 2.7 | 3.3 |
| 23 | 3.75 | 3.25 | 3.5 | 3.3 | 3.4 | 3.15 | 2.65 | 2.3 | 2.6 | 2.7 | 2.7 | 3.4 |
| 24 | 3.7 | 3.3 | 3.45 | 3.3 | 3.45 | 3.15 | 2.65 | 2.4 | 2.6 | 2.7 | 2.7 | 3.4 |
| 25 | 3.6 | 3.3 | 3.45 | 3.25 | 3.55 | 3.1 | 2.6 | 2.5 | 2.6 | 2.8 | 2.7 | 3.5 |
| 26 | 3.6 | 3.3 | 3.5 | 3.3 | 3.55 | 3.1 | 2.55 | 2.5 | 2.6 | 2.9 | 2.8 | 3.5 |
| 27 | 3.6 | 3.25 | 3.5 | 3.3 | 3.6 | 3.1 | 2.4 | 2.5 | 2.6 | 2.9 | 2.85 | 3.5 |
| 28 | 3.6 | 3.3 | 3.45 | 3.3 | 3.6 | 3.0 | 2.32 | 2.55 | 2.6 | 3.0 | 2.9 | 3.5 |
| 29 | 3.6 | ....... | 3.45 | 3.35 | 3.6 | 3.0 | 2.3 | 2.55 | 2.6 | 3.1 | 3.0 | 3.5 |
| 30 | 3.55 | ....... | 3.45 | 3.4 | 3.55 | 3.0 | 2.25 | 2.6 | 2.6 | 3.2 | 3.0 | 3.5 |
| 31 | 3.5 | ....... | 3.5 | ....... | 3.6 | ....... | 2.2 | 2.6 | ....... | 3.3 | ....... | ...... |

NOTE.—Ice conditions exist at this station during the winter months. Ice 8 inches thick January 20.

*Station rating table for North Fork of Humboldt River near Elburz, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.30 | 0.0 | 2.70 | 0.8 | 3.10 | 14 | 3.50 | 41 |
| 2.40 | .2 | 2.80 | 1. | 3.20 | 20 | 3.60 | 49 |
| 2.50 | .4 | 2.90 | 3. | 3.30 | 27 | 3.70 | 57 |
| 2.60 | .6 | 3.00 | 8. | 3.40 | 34 | 3.80 | 66 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. Estimates based on this table can be considered only as approximate, and especially so for low stages. Zero flow at 2.3 feet is based on observer's statement.

*Estimated monthly discharge of North Fork of Humboldt River near Elburz, Nev., for 1905.*

[Drainage area, 1,020 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 66 | 41 | 53.3 | 3,277 | 0.052 | 0.060 |
| February | 41 | 17 | 29.0 | 1,611 | .028 | .029 |
| March | 41 | 34 | 38.8 | 2,386 | .038 | .044 |
| April | 41 | 20 | 28.9 | 1,720 | .028 | .031 |
| May | 57 | 27 | 43.8 | 2,693 | .043 | .050 |
| June | 45 | 8 | 28.0 | 1,666 | .027 | .030 |
| July | 2 | .0 | .96 | 59 | .00094 | .0011 |
| August | .6 | .0 | .12 | 7 | .00012 | .00014 |
| September | .6 | .4 | .50 | 30 | .00049 | .00055 |
| October | 27 | .6 | 2.9 | 178 | .0028 | .0032 |
| November | 27 | .8 | 7.8 | 464 | .0076 | .0085 |
| December | 41 | 8 | 19.1 | 1,174 | .019 | .022 |
| The year | 66 | 0 | 21.1 | 15,270 | .021 | .279 |

NOTE.—Open-channel rating table applied to the winter months without correction. Winter estimates liable to some error.

## SOUTH FORK OF HUMBOLDT RIVER NEAR ELKO, NEV.

This station was established August 29, 1896. It is located 10 miles southwest of the town of Elko, at Cislini's (formerly Mason's) ranch, and about 6 miles above the junction of South Fork with the main stream.

The channel is straight for some distance above and below the station and the banks are high. The bed of the stream is composed of gravel and is stable. There is a good site for a reservoir a short distance above the station.

Discharge measurements are made from a cable and suspended car at a point 1 mile above the gage.

The gage, which is placed near the farm of the observer, M. Cislini, for his convenience, is inclined and is spiked to posts driven firmly into the right bank. An inclined gage was installed November 22, 1902, at the site of the old one, the 4-foot marks of the old and new gages coinciding. The bench mark is a 4 by 4 inch timber driven 4 feet south of the gage; elevation above gage datum, 6.29 feet. A new gage was installed May 21, 1905, below a dam which was built just below the old gage. All gage heights for 1905 have been referred to this new datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, p 311; WS 16, p 156; 28, p 146; 38 pp 327-328; 51, p 396; 66, p 105; 85, p 101; 100, p 161; 133, p 294.

Discharge: Ann 18, iv, p 311; WS 16, p 156; 28, p 153; 38, p 328; 51, p 396; 66, p 105; 85, p 102; 100, p 161; 133, p 295.

Discharge, monthly: Ann 19, iv, p 430; 20, iv, p 440; 21, iv, p 391; 22, iv, p 400; WS 75, p 182; 85, p 103; 100, p 163; 133, p 296.

Discharge, yearly: Ann 20, iv, p 60.

Gage heights: WS 11, p 76; 16, p 165; 28, pp 148-149; 38, p 328; 51, p 397; 66, p 106; 85, p 102; 100, p 162; 133, p 295.

Hydrographs: Ann 19, iv, p 430; 20, iv, p 441; 21, iv, p 391; 22, iv, p 400.

Rating tables: Ann 19, iv, p 429; WS 28, p 154; 39, p 452; 52, p 520; 66, p 174; 85, p 102; 100, p 162; 133, p 296.

*Discharge measurements of South Fork of Humboldt River near Elko, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 26 | W. A. Wolf | | 109 | 2.24 | 1.55 | 244 |
| May 21 | do | 47 | 167 | 3.81 | 3.85 | 636 |
| June 4 | do | 46 | 157 | 3.62 | 3.60 | 568 |
| June 16 | do | 46 | 181 | 4.30 | 4.31 | 779 |
| June 27 | do | 45 | 122 | 2.89 | 2.88 | 324 |
| July 14 | do | 45 | 86 | 1.40 | 1.95 | 120 |
| September 7 | do | | | | .60 | [a] .5 |

[a] Estimated.

NOTE.—Beginning May 21 gage heights refer to new datum.

*Daily gage height, in feet, of South Fork Humboldt River near Elko, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.5 | 0.85 | ([a]) | 0.4 | 2.3 | 3.55 | 2.75 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 2 | .5 | 1.15 | ([a]) | .5 | 2.1 | 3.6 | 2.75 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 3 | .5 | 1.15 | ([a]) | .5 | 2.3 | 3.6 | 2.8 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 4 | .5 | 1.5 | ([a]) | 1.15 | 2.55 | 3.7 | 2.9 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 5 | .5 | 1.5 | ([a]) | 1.15 | 2.55 | 3.7 | 3.0 | 1.0 | 1.0 | 0 | 1.0 | 1.1 |
| 6 | .5 | 1.5 | 0.4 | 1.5 | 2.55 | 3.6 | 3.7 | 1.0 | 1.0 | 0 | 1.1 | 1.1 |
| 7 | .5 | 1.15 | .4 | 1.65 | 2.75 | 3.7 | 2.9 | 1.0 | 1.0 | 0 | 1.1 | 1.1 |
| 8 | .5 | .5 | ([a]) | 1.8 | 2.9 | 3.8 | 2.7 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 9 | .5 | .5 | ([a]) | 1.8 | 3.0 | 3.9 | 2.6 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 10 | .5 | .5 | .4 | 2.1 | 3.15 | 3.8 | 2.5 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 11 | .5 | .5 | .4 | 2.3 | 3.15 | 3.8 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 12 | .5 | .5 | .4 | 2.1 | 3.3 | 3.9 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 13 | .5 | .4 | .4 | 2.1 | 3.35 | 4.0 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 14 | .5 | .4 | .4 | 1.8 | 3.4 | 4.1 | 2.4 | 1.0 | .6 | 0 | 1.1 | 1.1 |
| 15 | .5 | ([a]) | .4 | 1.8 | 3.5 | 4.2 | 2.45 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 16 | .5 | ([a]) | .4 | 2.1 | 3.65 | 4.3 | 2.4 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 17 | .5 | ([a]) | .4 | 2.1 | 3.75 | 4.4 | 2.2 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 18 | .5 | ([a]) | .4 | 2.2 | 3.85 | 4.3 | 2.1 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 19 | .5 | ([a]) | .4 | 2.2 | 3.85 | 4.1 | 2.0 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 20 | .5 | ([a]) | .4 | 2.3 | 3.85 | 4.0 | 1.8 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 21 | .5 | ([a]) | .4 | 2.3 | 3.8 | 3.8 | 1.7 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 22 | .5 | ([a]) | .4 | 2.55 | 3.7 | 3.7 | 1.6 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 23 | .5 | ([a]) | .4 | 2.55 | 3.7 | 3.5 | 1.5 | 1.0 | .6 | 1.0 | 1.1 | 1.1 |
| 24 | .5 | ([a]) | .4 | 2.55 | 3.6 | 3.3 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 25 | .5 | ([a]) | .4 | 2.55 | 3.6 | 3.2 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 26 | .5 | .4 | .4 | 2.55 | 3.5 | 3.1 | 1.4 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 27 | .5 | .4 | 4 | 2.55 | 3.5 | 3.0 | 1.3 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 28 | .5 | .4 | .4 | 2.55 | 3.6 | 3.0 | 1.3 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 29 | .5 | | .4 | 2.55 | 3.5 | 2.9 | 1.2 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 30 | .5 | | .5 | 2.3 | 3.55 | 2.8 | 1.1 | 1.0 | 0 | 1.0 | 1.1 | 1.1 |
| 31 | .5 | | .4 | | 3.55 | | 1.1 | 1.0 | | 1.0 | | 1.1 |

[a] No flow.

*Station rating table for South Fork Humboldt River near Elko, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 0 | 1.70 | 88 | 2.90 | 350 | 4.10 | 720 |
| .60 | 1 | 1.80 | 102 | 3.00 | 380 | 4.20 | 752 |
| .70 | 3 | 1.90 | 117 | 3.10 | 410 | 4.30 | 784 |
| .80 | 7 | 2.00 | 133 | 3.20 | 440 | 4.40 | 816 |
| .90 | 12 | 2.10 | 150 | 3.30 | 470 | 4.50 | 848 |
| 1.00 | 18 | 2.20 | 168 | 3.40 | 500 | 4.60 | 880 |
| 1.10 | 25 | 2.30 | 189 | 3.50 | 530 | 4.70 | 912 |
| 1.20 | 33 | 2.40 | 212 | 3.60 | 560 | 4.80 | 944 |
| 1.30 | 42 | 2.50 | 238 | 3.70 | 592 | 4.90 | 976 |
| 1.40 | 52 | 2.60 | 264 | 3.80 | 624 | 5.00 | 1,008 |
| 1.50 | 63 | 2.70 | 292 | 3.90 | 656 | | |
| 1.60 | 75 | 2.80 | 320 | 4.00 | 688 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1905. It is fairly well defined between gage heights 2 feet and 4 feet. Below 2 feet the table is based on one measurement at 0.6 foot.

*Estimated monthly discharge of South Fork Humboldt River near Elko, Nev., for 1905.*

[Drainage area, 1,150 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 0 | 0 | 0 | 0 | 0 | 0 |
| February | 63 | 0 | 10.2 | 567 | .0089 | .0093 |
| March | 0 | 0 | 0 | 0 | 0 | 0 |
| April | 251 | 0 | 149 | 8,866 | .130 | .145 |
| May | 640 | 150 | 465 | 28,590 | .404 | .466 |
| June | 816 | 320 | 588 | 34,990 | .511 | .570 |
| July | 592 | 25 | 187 | 11,500 | .163 | .188 |
| August | 18 | 18 | 18 | 1,107 | .016 | .018 |
| September | 18 | 0 | 4.7 | 280 | .0041 | .0046 |
| October | 18 | 0 | 9.9 | 608 | .0086 | .0099 |
| November | 25 | 18 | 24.7 | 1,470 | .021 | .023 |
| December | 25 | 25 | 25 | 1,537 | .022 | .025 |
| The year | 816 | 0 | 123 | 89,520 | .107 | 1.46 |

## HUMBOLDT RIVER AT PALISADE, NEV.

This station was established November 27, 1902. It is located at the single-span highway bridge one-fourth mile from the hotel at Palisade, Nev. There is a railroad bridge about 500 feet below.

The channel is straight for 200 feet above and 300 feet below the station. The right bank is low and liable to overflow; the left is high. The bed of the stream is composed of gravel and sand and is permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car about one-fourth mile above the gage. At very low stages, when the current becomes sluggish at the cable, measurements are made by wading a short distance above. The initial point for soundings is the zero on the tagged wire.

The gage, which is read once each day by T. H. Jewell, the hotel keeper, is a vertical 1 by 4 inch board spiked to the right abutment of the bridge. The bench mark consists of a spike and three nails driven into the bridge abutment to which the gage is fastened; elevation above zero of gage, 7.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 100; 100, p 157; 133, p 286.
Dishcarge: 100, p 158; 133, p 286.
Discharge, monthly: 100, p 159; 133, p 288.
Gage heights: 85, p 100; 100, p 158; 133, p 287.
Rating table 100, p 159; 133, p 287.

*Discharge measurements of Humboldt River at Palisade, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 27 | W. A. Wolf | 102 | 258 | 1.88 | 3.10 | 485 |
| May 20 | do | 105 | 365 | 2.33 | 4.10 | 850 |
| June 4 | do | 105 | 414 | 2.23 | 4.20 | 923 |
| June 20 | do | 105 | 358 | 2.12 | 3.85 | 759 |
| June 27 | do | 105 | 358 | 2.11 | 3.85 | 756 |
| July 15 | do | 97 | 204 | 1.40 | 2.35 | 284 |
| September 8 | do | 10 | 10 | 1.30 | .90 | 13 |

*Daily gage height, in feet, of Humboldt River at Palisade, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.9 | 2.0 | 2.4 | 2.6 | 2.95 | 4.6 | 3.2 | 1.6 | 1.1 | 1.15 | 1.4 | 1.4 |
| 2 | 1.95 | 2.1 | 2.4 | 2.6 | 3.0 | 4.6 | 3.2 | 1.6 | 1.1 | 1.15 | 1.4 | 1.4 |
| 3 | 1.95 | 2.1 | 2.4 | 2.6 | 3.05 | 4.6 | 3.15 | 1.6 | 1.1 | 1.15 | 1.4 | 1.46 |
| 4 | 1.95 | 2.2 | 2.4 | 2.6 | 3.1 | 4.55 | 3.1 | 1.6 | 1.1 | 1.15 | 1.4 | 1.46 |
| 5 | 1.95 | 2.2 | 2.4 | 2.6 | 3.15 | 4.55 | 3.1 | 1.55 | 1.1 | 1.2 | 1.4 | 1.46 |
| 6 | 1.95 | 2.2 | 2.4 | 2.6 | 3.2 | 4.55 | 3.0 | 1.55 | 1.1 | 1.2 | 1.4 | 1.46 |
| 7 | 1.95 | 2.2 | 2.4 | 2.6 | 3.3 | 4.5 | 2.9 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 8 | 1.9 | 2.2 | 2.4 | 2.6 | 3.3 | 4.5 | 2.85 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 9 | 1.9 | 2.1 | 2.4 | 2.6 | 3.35 | 4.5 | 2.8 | 1.5 | 1.1 | 1.2 | 1.4 | 1.46 |
| 10 | 1.8 | 2.1 | 2.4 | 2.6 | 3.4 | 4.45 | 2.75 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 11 | 1.8 | 2.1 | 2.4 | 2.65 | 3.5 | 4.45 | 2.7 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 12 | 1.7 | 2.0 | 2.4 | 2.75 | 3.5 | 4.4 | 2.6 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 13 | 1.7 | 2.0 | 2.4 | 2.8 | 3.6 | 4.2 | 2.5 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 14 | 1.7 | 2.0 | 2.4 | 2.8 | 3.65 | 4.0 | 2.4 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 15 | 1.7 | 2.0 | 2.4 | 2.8 | 3.7 | 4.0 | 2.3 | 1.5 | 1.1 | 1.2 | 1.4 | 1.4 |
| 16 | 1.7 | 2.0 | 2.4 | 2.9 | 3.8 | 4.0 | 2.3 | 1.5 | 1.1 | 1.25 | 1.4 | 1.4 |
| 17 | 1.7 | 2.0 | 2.4 | 2.9 | 3.9 | 3.95 | 2.3 | 1.4 | 1.1 | 1.25 | 1.4 | 1.45 |
| 18 | 1.7 | 2.1 | 2.4 | 2.9 | 4.0 | 3.9 | .2 | 1.3 | 1.1 | 1.3 | 1.4 | 1.45 |
| 19 | 1.75 | 2.1 | 2.4 | 2.9 | 4.0 | 3.9 | 2.1 | 1.25 | 1.1 | 1.3 | 1.4 | 1.45 |
| 20 | 1.75 | 2.1 | 2.4 | 2.95 | 4.2 | 3.85 | 2.0 | 1.2 | 1.1 | 1.3 | 1.4 | 1.5 |
| 21 | 1.8 | 2.2 | 2.45 | 2.95 | 4.2 | 3.85 | 2.0 | 1.15 | 1.1 | 1.3 | 1.4 | 1.5 |
| 22 | 1.8 | 2.2 | 2.5 | 2.95 | 4.2 | 3.8 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.5 |
| 23 | 1.8 | 2.2 | 2.5 | 2.95 | 4.2 | 3.8 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.5 |
| 24 | 1.85 | 2.3 | 2.5 | 2.95 | 4.3 | 3.7 | 1.9 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 25 | 1.95 | 2.3 | 2.55 | 2.95 | 4.4 | 3.7 | 1.8 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 26 | 1.9 | 2.4 | 2.6 | 2.95 | 4.5 | 3.6 | 1.75 | 1.1 | 1.1 | 1.35 | 1.4 | 1.55 |
| 27 | 1.9 | 2.4 | 2.6 | 2.95 | 4.6 | 3.5 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.6 |
| 28 | 1.9 | 2.4 | 2.6 | 2.95 | 4.7 | 3.4 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.6 |
| 29 | 1.9 | ....... | 2.6 | 2.95 | 4.8 | 3.3 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.65 |
| 30 | 2.0 | ....... | 2.6 | 2.95 | 4.7 | 3.2 | 1.75 | 1.1 | 1.1 | 1.4 | 1.4 | 1.7 |
| 31 | 2.0 | ....... | 2.6 | ....... | 4.6 | ....... | 1.6 | 1.1 | ....... | 1.4 | ....... | 1.7 |

*Station rating table for Humboldt River at Palisade, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 34 | 2.10 | 203 | 3.10 | 498 | 4.00 | 850 |
| 1.20 | 46 | 2.20 | 227 | 3.20 | 534 | 4.10 | 895 |
| 1.30 | 59 | 2.30 | 253 | 3.30 | 570 | 4.20 | 940 |
| 1.40 | 72 | 2.40 | 280 | 3.40 | 607 | 4.30 | 985 |
| 1.50 | 86 | 2.50 | 308 | 3.50 | 645 | 4.40 | 1,030 |
| 1.60 | 102 | 2.60 | 337 | 3.60 | 684 | 4.50 | 1,075 |
| 1.70 | 120 | 2.70 | 367 | 3.70 | 724 | 4.60 | 1,120 |
| 1.80 | 139 | 2.80 | 398 | 3.80 | 765 | 4.70 | 1,170 |
| 1.90 | 159 | 2.90 | 430 | 3.90 | 807 | 4.80 | 1,220 |
| 2.00 | 180 | 3.00 | 463 | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is fairly well defined.

*Estimated monthly discharge of Humboldt River at Palisade, Nev., for 1905.*

[Drainage area, 5,014 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 180 | 120 | 149 | 9,162 | 0.030 | 0.035 |
| February | 280 | 180 | 216 | 12,000 | .043 | .045 |
| March | 337 | 280 | 296 | 18,200 | .059 | .068 |
| April | 446 | 337 | 397 | 23,620 | .079 | .088 |
| May | 1,220 | 446 | 793 | 48,760 | .158 | .182 |
| June | 1,120 | 534 | 884 | 52,600 | .176 | .196 |
| July | 534 | 102 | 286 | 17,580 | .057 | .066 |
| August | 102 | 34 | 66.6 | 4,095 | .013 | .015 |
| September | 34 | 34 | 34.0 | 2,023 | .0068 | .0076 |
| October | 72 | 40 | 54.7 | 3,363 | .011 | .013 |
| November | 72 | 72 | 72.0 | 4,284 | .014 | .016 |
| December | 120 | 72 | 85.2 | 5,239 | .017 | .020 |
| The year | 1,220 | 34 | 278 | 200,900 | .055 | .752 |

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction.

## HUMBOLDT RIVER NEAR GOLCONDA, NEV.

This station was established October 24, 1894. It is located 1¼ miles north of the town of Golconda, near the great northern bend of Humboldt River and below the central valley, and is about 12 miles above the mouth of Little Humboldt River.

The channel is straight for 300 feet above and 100 feet below the station. The banks are moderately high, but are liable to overflow at extreme high water. The bed of the stream is of gravel and sand and is somewhat shifting. There is but one channel at all stages.

Measurements prior to 1904 were made from a cable and suspended car. Subsequent measurements have been made from the upper side of a wagon bridge, constructed during the winter of 1903–4, 10 feet above the cable. At low stages, when the current is sluggish, measurements can be made by wading above or below the cable.

The gage was read during 1905 by Charles Shallenberger. A new gage and bench mark were established October 4, 1904, replacing the inclined gage installed November 28, 1902, which was fastened to the left bank by 4 by 4 inch stakes, and the zero of which had the same elevation as the original gage. The new gage is a 4 by 4 inch timber, driven vertically into the river bed, and its upper end is securely fastened to a stringer on the downstream side of the north or right end of the wagon bridge. The bench mark of the old gage was a 4 by 4 inch timber, driven 4 feet north of the cable post on the left bank, at an elevation of 10.75 feet above the zero of the gage. The new bench mark is the head of the lowest rivet of the strut at the northwest corner of the bridge; elevation above zero of new gage, 13.42 feet. The new bench mark is 0.48 foot lower than the old bench mark, so that the new gage zero is 3.15 feet below the old zero.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 303–304; Bull 131, p 52; 140, pp 217–218; WS 16, p 154; 28, p 146; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, pp 288–289.

Discharge: Ann 18, iv, pp 304–305; Bull 131, p 92; 140, p 218; WS 16, p 154; 28, p 153; 38, p 329; 51, p 397; 66, p 106; 85, p 98; 100, p 155; 133, p 289.

Discharge, monthly: Ann 18, iv, p 306; 19, iv, p 427; 20, iv, p 438; 21, iv, p 392; 22, iv, p 401; Bull 140, p 220; WS 75, p 182; 85, p 100; 100, p 157; 133, p 291.

Discharge, yearly: Ann 20, iv, p 59.

Gage heights: Bull 140, p 219; WS 11, p 74; 16, p 154; 28, p 148; 38, p 329; 51, p 398; 66, p 107; 85, p 99; 100, p 156; 133, p 290.

Hydrographs: Ann 19, iv, p 429; 20, iv, p 439; 21, iv, p 392; 22, iv, p 401.

Rating tables: Ann 19, iv, p 427; WS 28, p 154; 39, p 452; 52, p 520; 66, p 175; 85, p 99; 100, p 156; 133, p 291.

*Discharge measurements of Humboldt River near Golconda, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 25 | W. A. Wolf | 63 | 200 | 0.58 | 6.55 | 116 |
| May 19 | do | 73 | 234 | 1.30 | 6.95 | 302 |
| June 2 | do | 62 | 153 | 1.33 | 5.98 | 203 |
| June 15 | do | 62 | 160 | 1.60 | 6.40 | 257 |
| June 28 | do | 60 | 166 | 1.43 | 6.30 | 238 |
| July 13 | do | 59 | 172 | 1.46 | 6.35 | 252 |
| September 6 | do | | | | 3.10 | [a] .5 |

[a] Estimated.

*Daily gage height, in feet, of Humboldt River near Golconda, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.7 | 6.2 | | | | 7.4 | | 4.7 | | 3.0 | 3.0 | 3.0 |
| 2 | | | 6.2 | | 7.0 | | | 4.7 | | | | |
| 3 | 5.5 | | | | | 5.9 | | 4.6 | | 3.0 | | 3.0 |
| 4 | | 6.0 | | 6.4 | 7.1 | 6.0 | 6.5 | 4.3 | | 3.0 | | 3.0 |
| 5 | 5.3 | 5.9 | 6.2 | 6.4 | 7.0 | | 6.5 | | | 3.0 | | 3.0 |
| 6 | | | 6.3 | | 6.9 | 5.9 | 6.5 | 4.1 | 3.1 | | 3.0 | |
| 7 | 5.5 | | 6.3 | 6.0 | 7.0 | 6.2 | | 4.1 | 3.1 | | 3.0 | |
| 8 | 5.5 | 5.9 | | 5.8 | | | 6.3 | | 3.1 | | 3.0 | |
| 9 | | 6.0 | | 6.5 | 6.8 | | | | 3.1 | | 3.0 | 2.9 |
| 10 | | 6.1 | | | 6.4 | 6.2 | 6.3 | | | | | |
| 11 | 5.6 | | | | | 6.4 | | 3.9 | | | | |
| 12 | 5.3 | 6.0 | 6.2 | 6.8 | 6.4 | 6.2 | 6.0 | 3.9 | | | | 2.9 |
| 13 | 5.0 | | 6.2 | 7.0 | | 6.0 | 6.0 | 3.7 | 3.0 | | 3.0 | 2.9 |
| 14 | | | | | | 6.0 | | 3.7 | 3.0 | | 3.0 | 2.9 |
| 15 | 5.0 | 5.8 | 6.1 | 7.0 | | | 5.9 | 3.6 | 2.9 | | 3.0 | 2.9 |
| 16 | | | 6.3 | 7.0 | | | 5.7 | | 2.8 | 2.9 | 3.0 | |
| 17 | | 5.6 | | 7.0 | 6.9 | | | | | | | |
| 18 | 5.3 | 5.6 | | | 6.9 | 6.0 | | 3.4 | 2.9 | 3.0 | | |
| 19 | | 5.6 | 5.6 | 6.8 | 6.9 | 6.0 | 5.5 | | | 2.9 | | |
| 20 | 5.6 | | | | 7.0 | | | | | 3.0 | 3.0 | |
| 21 | 6.3 | | | | | | 5.4 | 3.3 | 3.0 | | | 3.0 |
| 22 | 5.8 | 5.7 | 6.0 | 6.5 | 7.0 | 6.3 | 5.4 | 3.3 | 3.0 | | 2.9 | 3.0 |
| 23 | | | 6.0 | | | 6.5 | | | 3.0 | 2.9 | 3.0 | 3.0 |
| 24 | | 5.9 | 6.0 | 6.5 | 7.1 | | | 3.2 | | 2.9 | 3.0 | 3.0 |
| 25 | 5.4 | 5.9 | 6.2 | 6.4 | 7.3 | 6.9 | 5.1 | | | 3.0 | | |
| 26 | | 6.0 | 5.9 | | | | 5.1 | 3.0 | 3.0 | | 3.0 | 3.0 |
| 27 | 5.2 | | | 6.8 | 7.3 | 6.9 | | 3.1 | | | 3.0 | 2.9 |
| 28 | 5.4 | | 6.0 | | | 6.5 | 5.0 | | 3.0 | | | 3.0 |
| 29 | | | | 7.0 | | | 4.9 | 3.1 | 3.0 | 3.0 | | 3.0 |
| 30 | 5.4 | | 6.4 | | 7.4 | 6.5 | | 3.0 | 2.9 | 3.0 | | |
| 31 | 6.0 | | 6.4 | | 7.4 | | | 3.1 | | 3.0 | | |

*Station rating table for Humboldt River near Golconda, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.80 | 0.0 | 4.00 | 39.0 | 5.20 | 132.0 | 6.40 | 247.0 |
| 2.90 | 0.1 | 4.10 | 46.0 | 5.30 | 141.0 | 6.50 | 257.0 |
| 3.00 | .3 | 4.20 | 53.0 | 5.40 | 150.0 | 6.60 | 268.0 |
| 3.10 | .5 | 4.30 | 60.0 | 5.50 | 159.0 | 6.70 | 279.0 |
| 3.20 | 2.0 | 4.40 | 67.0 | 5.60 | 168.0 | 6.80 | 290.0 |
| 3.30 | 5.0 | 4.50 | 75.0 | 5.70 | 177.0 | 6.90 | 301.0 |
| 3.40 | 8.0 | 4.60 | 83.0 | 5.80 | 187.0 | 7.00 | 312.0 |
| 3.50 | 12.0 | 4.70 | 91.0 | 5.90 | 197.0 | 7.10 | 323.0 |
| 3.60 | 16.0 | 4.80 | 99.0 | 6.00 | 207.0 | 7.20 | 334.0 |
| 3.70 | 21.0 | 4.90 | 107.0 | 6.10 | 217.0 | 7.30 | 345.0 |
| 3.80 | 27.0 | 5.00 | 115.0 | 6.20 | 227.0 | 7.40 | 356.0 |
| 3.90 | 33.0 | 5.10 | 123.0 | 6.30 | 237.0 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and the form of previous curves. It is well defined between gage heights 6 feet and 7 feet. Below gage height 6 feet it is only approximate.

*Estimated monthly discharge of Humboldt River near Golconda, Nev., for 1905.*

[Drainage area, 10,780 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 237 | 115 | 155 | 9,531 | 0.014 | 0.016 |
| February | 227 | 168 | 196 | 10,880 | .018 | .019 |
| March | 247 | 168 | 218 | 13,400 | .020 | .023 |
| April | 312 | 187 | 272 | 16,180 | .025 | .028 |
| May | 356 | 247 | 308 | 18,940 | .029 | .033 |
| June | 356 | 197 | 239 | 14,220 | .022 | .024 |
| July | 257 | 95 | 184 | 11,310 | .017 | .020 |
| August | 91 | .3 | 25.0 | 1,537 | .0023 | .0026 |
| September | .5 | .0 | .33 | 19.6 | .000031 | .000035 |
| October | .3 | .1 | .23 | 14.1 | .000021 | .000024 |
| November | .3 | .1 | .29 | 17.3 | .000027 | .000030 |
| December | .3 | .1 | .22 | 13.5 | .000020 | .000023 |
| The year | 356 | 0 | 133 | 96,060 | .012 | .166 |

**Note.**—Ice conditions not known. Open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

## HUMBOLDT RIVER NEAR OREANA, NEV.

This station was established January 27, 1896. It is located near Oreana, Nev., about 12 miles northeast of Lovelocks. The results of the observations at this locality show the amount of water available for storage at the possible reservoir sites in the vicinity of Humboldt station, and also for the six canal systems now in operation below Oreana.

The channel is straight for 300 feet above and 200 feet below the station. The right bank is high and will not overflow; the left bank will overflow only at extreme high water. There is but one channel at all stages. The bed of the stream is sandy and shifting.

Discharge measurements are made at high water by means of a cable and car located at the gage. At low water measurements are made by wading a short distance below the station.

The gage was read once each day during 1905 by J. J. McCarthy. The original gage was located at the old Oreana highway bridge. The abutment to which the gage was fastened was undermined and fell May 26, 1897. A temporary gage was used until September 8, 1897, when a new inclined one was placed on the left bank of the river, about 1½ miles above the site of the old gage and opposite the section house of the Central Pacific Railroad. This gage was washed out. The present gage was established November 29, 1902. It is vertical, in two sections, and is spiked to piles at the site of the old dam. The bench mark consists of four nails driven into the pile to which the upper section of the gage is fastened; elevation above zero of gage, 5.00 feet. On October 1, 1904, the gage rod was lowered 2.00 feet, and the elevation of the bench mark is now 7.00 feet above the zero of the gage:

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 306; Bull 140, p 220; WS 16, p 155; 28, p 146; 38, p 330; 51, p 398; 66, p 107; 85, p 96; 100, pp 152-153; 133, p 292.

Discharge: Ann 18, iv, p 307; WS 16, p 155; 28, p 153; 38, p 330; 51, p 398; 66, p 107; 85, p 97; 100, p 153; 133, p 292.

Discharge, monthly: Ann 18, iv, p 308; 19, iv, p 428; 20, iv, p 439; 21, iv, p 393; 22, iv, p 402; WS 75, p 183; 85, p 98; 100, p. 154; 133, p 294.

Discharge, yearly: Ann 20, iv, p 60.

Gage heights: WS 11, p 75; 16, p 155; 28, p 148; 38, p 330; 51, p 399; 66, p 108; 85, p 97; 100, p 153; 133, p 293.

Hydrographs: Ann 18, iv, p 309; 19, iv, p 429; 20, iv, p 440; 21, iv, p 393; 22, iv, p 402; WS 75, p 183.

Rating tables: Ann 18, iv, p 307; 19, iv, p 428; WS 28, p 154; 39, p 452; 52, p 520; 66, p 175; 85, p 97, 100, p 154; 133, p 293:

*Discharge measurements of Humboldt River near Oreana, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 25 | W. A. Wolf | 60 | 39 | 1.34 | 2.11 | 52 |
| May 18 | do | 22 | 12 | 1.12 | 1.71 | 13.4 |
| May 30 | do | 20 | 10 | 1.08 | 1.61 | 10.8 |
| July 12 | do | 100 | 112 | 1.77 | 2.95 | 198 |
| July 31 | do | 100 | 100 | 1.70 | 2.75 | 178 |
| September 5 | do | 16 | 16 | 0.90 | 1.78 | 14 |

*Daily gage height, in feet, of Humboldt River near Oreana, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.9 | 3.0 | 3.75 | 2.6 | 1.8 | 1.6 | 1.0 | 2.75 | 1.8 | 1.75 | 1.9 | 2.1 |
| 2 | 3.6 | 2.9 | 3.1 | 2.6 | 1.95 | 1.55 | 1.0 | 2.7 | 1.8 | 1.75 | 1.9 | 2.1 |
| 3 | 3.4 | 3.0 | 3.1 | 2.65 | 1.8 | 1.55 | 1.0 | 2.6 | 1.85 | 1.7 | 1.9 | 2.1 |
| 4 | 3.5 | 2.9 | 3.1 | 2.7 | 1.75 | 1.55 | 1.55 | 2.6 | 1.85 | 1.7 | 1.9 | 2.1 |
| 5 | 3.5 | 2.9 | 3.1 | 2.7 | 1.75 | 1.55 | 1.6 | 2.55 | 1.8 | 1.75 | 1.95 | 2.15 |
| 6 | 3.4 | 2.8 | 3.1 | 2.7 | 1.6 | 1.5 | 1.65 | 2.55 | 1.8 | 1.75 | 1.95 | 2.15 |
| 7 | 3.4 | 2.8 | 3.1 | 2.7 | 1.65 | 1.5 | 1.8 | 2.6 | 1.85 | 1.75 | 1.95 | 2.1 |
| 8 | 3.5 | 2.7 | 3.12 | 2.6 | 1.65 | 1.5 | 1.8 | 2.6 | 1.85 | 1.75 | 1.9 | 2.1 |
| 9 | 3.4 | 2.7 | 3.11 | 2.6 | 1.64 | 1.5 | 2.95 | 2.55 | 1.8 | 1.75 | 1.9 | 2.1 |
| 10 | 3.2 | 3.0 | 3.11 | 2.6 | 1.65 | 1.45 | 3.45 | 2.55 | 1.8 | 1.8 | 1.9 | 2.1 |
| 11 | 3.1 | 3.1 | 3.1 | 2.55 | 1.75 | 1.4 | 3.3 | 2.5 | 1.75 | 1.8 | 1.9 | 2.1 |
| 12 | 3.1 | 3.45 | 3.45 | 2.5 | 1.7 | 1.4 | 3.25 | 2.5 | 1.75 | 1.75 | 1.9 | 2.1 |
| 13 | 3.2 | 3.3 | 3.3 | 2.4 | 1.7 | 1.4 | 2.9 | 2.55 | 1.75 | 1.75 | 1.95 | 2.05 |
| 14 | 3.1 | 2.94 | 3.1 | 2.4 | 1.75 | 1.35 | 2.85 | 2.5 | 1.8 | 1.8 | 1.95 | 2.05 |
| 15 | 3.3 | 3.1 | 3.11 | 2.3 | 1.75 | 1.35 | 2.8 | 2.45 | 1.75 | 1.8 | 1.9 | 2.1 |
| 16 | 3.4 | 3.3 | 3.0 | 2.3 | 1.73 | 1.35 | 3.1 | 2.4 | 1.7 | 1.8 | 1.9 | 2.1 |
| 17 | 3.2 | 3.4 | 3.0 | 2.25 | 1.72 | 1.35 | 3.3 | 2.35 | 1.75 | 1.75 | 1.9 | 2.1 |
| 18 | 3.2 | 3.35 | 3.0 | 2.2 | 1.73 | 1.3 | 3.35 | 2.3 | 1.75 | 1.75 | 1.9 | 2.1 |
| 19 | 3.2 | 3.4 | 2.8 | 2.25 | 1.73 | 1.1 | 3.35 | 2.2 | 1.7 | 1.8 | 1.9 | 2.05 |
| 20 | 3.2 | 3.1 | 2.8 | 2.2 | 1.73 | 1.1 | 2.8 | 2.2 | 1.75 | 1.8 | 1.9 | 2.1 |
| 21 | 3.2 | 3.75 | 2.9 | 2.2 | 1.73 | 1.2 | 2.7 | 2.25 | 1.75 | 1.8 | 1.95 | 2.1 |
| 22 | 3.0 | 3.5 | 2.7 | 2.1 | 1.73 | 1.0 | 2.75 | 2.25 | 1.75 | 1.85 | 1.95 | 2.15 |
| 23 | 2.8 | 3.0 | 2.75 | 2.5 | 1.7 | 1.0 | 2.85 | 2.3 | 1.7 | 1.85 | 1.95 | 2.2 |
| 24 | 2.8 | 2.95 | 2.7 | 2.5 | 1.7 | 1.0 | 2.7 | 2.3 | 1.7 | 1.85 | 1.95 | 2.25 |
| 25 | 2.9 | 2.93 | 2.7 | 2.1 | 1.65 | 1.0 | 2.75 | 2.25 | 1.7 | 1.85 | 1.95 | 2.3 |
| 26 | 2.9 | 3.75 | 2.65 | 2.0 | 1.65 | 1.0 | 2.8 | 2.2 | 1.75 | 1.9 | 2.0 | 2.3 |
| 27 | 2.8 | 3.7 | 2.7 | 2.0 | 1.6 | 1.0 | 2.7 | 2.1 | 1.75 | 1.9 | 2.0 | 2.35 |
| 28 | 2.8 | 3.5 | 2.7 | 2.0 | 1.65 | 1.0 | 2.85 | 2.0 | 1.75 | 1.9 | 3.05 | 2.35 |
| 29 | 2.9 | ....... | 2.54 | 2.0 | 1.65 | 1.0 | 2.95 | 1.9 | 1.75 | 1.9 | 2.05 | 2.4 |
| 30 | 3.0 | ....... | 2.51 | 1.8 | 1.65 | 1.0 | 2.8 | 1.9 | 1.75 | 1.85 | 2.05 | 2.4 |
| 31 | 2.9 | ....... | 2.6 | ....... | 1.6 | ....... | 2.75 | 1.9 | ....... | 1.85 | ....... | 2.4 |

NOTE.—Ice conditions January 1 to February 19. Water stood in pools June 22 to July 3.

*Station rating table for Humboldt River near Oreana, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 0.0 | 1.90 | 29.0 | 2.70 | 152.0 | 3.50 | 335.0 |
| 1.20 | .5 | 2.00 | 40.0 | 2.80 | 172.0 | 3.60 | 360.0 |
| 1.30 | 1.0 | 2.10 | 53.0 | 2.90 | 193.0 | 3.70 | 385.0 |
| 1.40 | 2.0 | 2.20 | 67.0 | 3.00 | 215.0 | 3.80 | 412.0 |
| 1.50 | 3.5 | 2.30 | 82.0 | 3.10 | 238.0 | 3.90 | 440.0 |
| 1.60 | 7.0 | 2.40 | 98.0 | 3.20 | 261.0 | | |
| 1.70 | 12.0 | 2.50 | 115.0 | 3.30 | 285.0 | | |
| 1.80 | 20.0 | 2.60 | 133.0 | 3.40 | 310.0 | | |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is fairly well defined between gage heights 1.6 feet and 3 feet. It is only approximate below gage height 1.6 feet.

*Estimated monthly discharge of Humboldt River near Oreana, Nev., for 1905.*

[Drainage area, 13,800 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 440 | 172 | 260 | 15,990 | 0.019 | .022 |
| February | 398 | 152 | 252 | 14,000 | .018 | .019 |
| March | 398 | 117 | 209 | 12,850 | .015 | .017 |
| April | 152 | 20 | 96.0 | 5,712 | .0070 | .0078 |
| May | 34 | 7 | 13.2 | 812 | .00096 | .0011 |
| June | 7 | 0 | 1.94 | 115 | .00014 | .00016 |
| July | 322 | 0 | 156 | 9,592 | .011 | .013 |
| August | 162 | 29 | 95.8 | 5,860 | .0069 | .0080 |
| September | 24 | 12 | 17.3 | 1,029 | .0013 | .0014 |
| October | 29 | 12 | 20.0 | 1,230 | .0014 | .0016 |
| November | 46 | 29 | 33.1 | 1,970 | .0024 | .0027 |
| December | 98 | 46 | 62.7 | 3,855 | .0045 | .0052 |
| The year | 440 | 0 | 101 | 73,020 | .0073 | .099 |

NOTE.—Ice conditions January 1 to February 19. Open-channel rating table applied to the winter months without correction. Winter estimates liable to considerable error.

## SIERRA NEVADA DRAINAGE.

### PRINCIPAL STREAMS.

The Sierra Nevada drainage area includes the western part of Nevada, the eastern part of California, and a small part of south-central Oregon. The principal rivers of the area, with the bodies of water into which they discharge, are the following: Truckee River into Pyramid and Winnemucca lakes, Walker River into Walker Lake, Carson River into Carson Sink, Susan River into Honey Lake, and Owens River into Owens Lake.

## TRUCKEE RIVER BASIN.

### DESCRIPTION OF BASIN.

Upper Truckee River rises on the eastern slopes of the Sierra Nevada, in Eldorado County, Cal., and flows northward, entering Lake Tahoe from the south. The main Truckee leaves the lake, of which it forms the outlet, at the town of Tahoe, in eastern Placer County, Cal., flows north and northeast, and discharges, in Washoe County, Nev., into Pyramid and Winnemucca lakes, which have no outflowing streams. The drainage basin is wild and mountainous, the highest peaks reaching altitudes exceeding 10,000 feet. Lake Tahoe, which lies at an elevation of 6,225 feet above sea, has an area of 193 square miles and is the largest body of fresh water in the United States at this altitude.

In the lower part of its course the Truckee receives several important tributaries, among which may be mentioned Donner and Prosser creeks and Little Truckee River, the latter uniting with the main stream at the town of Boca. Independence Creek is a branch of the Little Truckee.

### TRUCKEE RIVER NEAR WADSWORTH, NEV.

This station was established November 6, 1902. It is located one-fourth mile west of the school at the Indian agency and is 18 miles north of Wadsworth, Nev.

The channel is straight for 200 feet above and below the cable. The right bank is low and is liable to overflow beyond the cable support at very high water; the left bank is high and will not overflow. The bed of the stream is composed of sand and gravel and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made by means of a cable and car about 200 feet below the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which was read during 1905 twice each day by Edward C. Wood, is a 4 by 4 inch vertical timber spiked to a cottonwood tree on the right bank. The bench mark consists of three nails driven into the root of a cottonwood tree 18 feet north of the gage; elevation above gage zero, 12.07 feet. The gage was disturbed by a flood early in February, 1904, and settled 0.31 foot, so that the elevation of the bench mark is 12.38 feet above the zero of the present gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 188; 133, pp 298-299.
Discharge: 100, p 188; 133, p 299.
Discharge, monthly: 100, p 190; 133, p 300.
Gage heights: 100, pp 188-189; 133, p 299.
Rating table: 100, p 189; 133, p 300.

*Discharge measurements of Truckee River near Wadsworth, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 18 | W. A. Wolf | 124 | 528 | 2.48 | 6.42 | 1,314 |
| June 8 | do | 127 | 418 | 2.15 | 5.85 | 898 |
| July 11 | do | 120 | 254 | 1.26 | 4.58 | 321 |

*Daily gage height, in feet, of Truckee River near Wadsworth, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.3 | 5.38 | 6.35 | 5.52 | 6.65 | 6.38 | 4.85 | 3.85 | 4.05 | 4.77 | 5.1 | 4.97 |
| 2 | 6.1 | 5.57 | 6.38 | 5.6 | 6.55 | 6.4 | 4.82 | 3.82 | 4.1 | 4.7 | 5.02 | 5.0 |
| 3 | 6.0 | 5.6 | 6.4 | 5.6 | 6.58 | 6.3 | 4.78 | 3.82 | 4.1 | 4.65 | 5.0 | 5.05 |
| 4 | 6.0 | 5.7 | 6.4 | 5.8 | 6.75 | 6.22 | 4.65 | 3.8 | 4.07 | 4.52 | 4.9 | 5.07 |
| 5 | 6.0 | 5.65 | 6.4 | 5.8 | 6.4 | 6.15 | 4.8 | 3.8 | 4.05 | 4.6 | 4.9 | 5.07 |
| 6 | 6.0 | 5.65 | 6.48 | 5.88 | 6.35 | 5.98 | 4.82 | 3.8 | 4.25 | 4.4 | 4.8 | 4.9 |
| 7 | 5.9 | 5.4 | 6.5 | 6.0 | 6.2 | 5.92 | 4.75 | 3.9 | 4.22 | 4.65 | 4.82 | 4.95 |
| 8 | 5.85 | 5.35 | 6.55 | 6.0 | 6.2 | 5.89 | 4.64 | 3.8 | 4.25 | 4.75 | 4.82 | 4.9 |
| 9 | 5.85 | 5.3 | 6.58 | 6.0 | 6.2 | 5.85 | 4.64 | 3.8 | 4.4 | 4.87 | 4.75 | 4.82 |
| 10 | 5.85 | 5.38 | 6.55 | 6.1 | 6.25 | 5.82 | 4.52 | 3.8 | 4.4 | 4.95 | 4.7 | 4.8 |
| 11 | 5.85 | 5.55 | 6.48 | 6.18 | 6.02 | 6.08 | 4.52 | 3.8 | 4.4 | 5.0 | 4.72 | 4.77 |
| 12 | 5.98 | 5.48 | 6.5 | 5.98 | 5.95 | 6.15 | 4.4 | 3.8 | 4.3 | 5.0 | 4.7 | 4.77 |
| 13 | 5.9 | 5.4 | 6.48 | 5.82 | 5.9 | 6.4 | 4.36 | 3.8 | 4.3 | 5.12 | 4.72 | 4.87 |
| 14 | 5.9 | 5.4 | 6.58 | 5.78 | 5.95 | 6.18 | 4.35 | 4.05 | 4.25 | 5.02 | 4.7 | 4.97 |
| 15 | 5.9 | 5.6 | 6.5 | 5.7 | 6.05 | 6.12 | 4.4 | 4.0 | 4.25 | 5.05 | 4.6 | 5.0 |
| 16 | 5.55 | 5.5 | 6.35 | 5.7 | 6.22 | 6.1 | 4.36 | 4.0 | 4.25 | 5.27 | 4.6 | 5.0 |
| 17 | 5.5 | 5.5 | 6.0 | 5.65 | 6.5 | 6.0 | 4.22 | 3.95 | 4.15 | 5.25 | 4.62 | 4.85 |
| 18 | 5.4 | 5.55 | 6.0 | 5.65 | 6.95 | 6.12 | 4.1 | 3.95 | 4.17 | 5.2 | 4.92 | 4.7 |
| 19 | 5.32 | 5.55 | 6.0 | 5.65 | 6.8 | 5.92 | 4.1 | 4.0 | 4.17 | 5.25 | 5.0 | 4.72 |
| 20 | 5.3 | 5.58 | 6.0 | 5.52 | 6.7 | 5.95 | 4.0 | 4.0 | 4.2 | 5.1 | 5.07 | 4.67 |
| 21 | 5.3 | 6.0 | 6.0 | 5.3 | 6.7 | 5.85 | 3.98 | 4.0 | 4.2 | 5.2 | 5.22 | 4.85 |
| 22 | 5.55 | 5.85 | 6.0 | 5.2 | 6.82 | 5.85 | 3.98 | 4.05 | 4.4 | 4.92 | 5.0 | 5.1 |
| 23 | 5.68 | 6.02 | 5.7 | 5.18 | 6.6 | 5.7 | 3.95 | 4.18 | 4.34 | 5.0 | 5.0 | 4.65 |
| 24 | 5.6 | 6.05 | 5.65 | 5.25 | 6.12 | 5.58 | 4.0 | 4.25 | 4.22 | 4.95 | 5.12 | 4.7 |
| 25 | 5.55 | 6.2 | 5.7 | 5.35 | 6.5 | 5.45 | 3.9 | 4.25 | 4.4 | 4.9 | 5.2 | 4.77 |
| 26 | 5.42 | 6.3 | 5.65 | 5.84 | 6.5 | 5.32 | 3.88 | 4.25 | 4.51 | 5.05 | 5.0 | 4.9 |
| 27 | 5.4 | 6.35 | 6.1 | 7.12 | 6.68 | 5.15 | 3.9 | 4.2 | 4.4 | 5.1 | 5.0 | 4.97 |
| 28 | 5.4 | 6.38 | 6.0 | 6.8 | 6.45 | 5.1 | 3.9 | 4.12 | 4.52 | 5.1 | 5.02 | 5.0 |
| 29 | 5.38 | ....... | 5.88 | 6.68 | 6.6 | 4.92 | 3.88 | 4.0 | 4.52 | 5.05 | 4.95 | 5.0 |
| 30 | 5.3 | ....... | 5.78 | 6.7 | 6.52 | 4.82 | 3.85 | 4.07 | 4.5 | 5.05 | 4.95 | 4.85 |
| 31 | 5.3 | ....... | 5.55 | ....... | 6.5 | ....... | 3.85 | 4.05 | ....... | 4.95 | ....... | 4.92 |

*Station rating table for Truckee River near Wadsworth, Nev., from January 1 to December 31, 1905.*

| Gage height | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.80 | 108 | 4.70 | 358 | 5.60 | 770 | 6.50 | 1,350 |
| 3.90 | 131 | 4.80 | 394 | 5.70 | 825 | 6.60 | 1,430 |
| 4.00 | 155 | 4.90 | 432 | 5.80 | 885 | 6.70 | 1,510 |
| 4.10 | 180 | 5.00 | 472 | 5.90 | 945 | 6.80 | 1,595 |
| 4.20 | 206 | 5.10 | 515 | 6.00 | 1,005 | 6.90 | 1,685 |
| 4.30 | 233 | 5.20 | 560 | 6.10 | 1,070 | 7.00 | 1,775 |
| 4.40 | 262 | 5.30 | 610 | 6.20 | 1,135 | 7.10 | 1,865 |
| 4.50 | 292 | 5.40 | 660 | 6.30 | 1,205 | 7.20 | 1,955 |
| 4.60 | 324 | 5.50 | 715 | 6.40 | 1,275 | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 4.6 feet and 8 feet.

*Estimated monthly discharge of Truckee River near Wadsworth, Nev., for 1905.*

[Drainage area, 2,130 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,205 | 610 | 826 | 50,790 | 0.388 | 0.447 |
| February | 1,261 | 610 | 827 | 45,930 | .388 | .404 |
| March | 1,414 | 742 | 1,133 | 69,670 | .532 | .613 |
| April | 1,883 | 551 | 935 | 55,640 | .439 | .490 |
| May | 1,730 | 945 | 1,306 | 80,300 | .613 | .707 |
| June | 1,275 | 402 | 935 | 55,640 | .439 | .490 |
| July | 413 | 120 | 241 | 14,820 | .113 | .130 |
| August | 220 | 108 | 148 | 9,100 | .069 | .080 |
| September | 298 | 168 | 229 | 13,630 | .108 | .120 |
| October | 595 | 262 | 457 | 28,100 | .215 | .248 |
| November | 570 | 324 | 434 | 25,820 | .204 | .228 |
| December | 515 | 341 | 433 | 26,620 | .203 | .234 |
| The year | 1,883 | 108 | 659 | 476,100 | .309 | 4.19 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

## TRUCKEE RIVER AT VISTA, NEV.

This station was established August 18, 1899. It is located 7 miles east of Reno, Nev., and one-fourth mile from the Southern Pacific Railroad station at Vista.

The channel is straight for 150 feet above and 400 feet below the station. Both banks are high; the left is liable to overflow at extreme high stages only. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car below the railroad bridge. The initial point for soundings is the zero of the tagged wire.

During 1905 the gage was read once each day by Patrick Fay. The original gage was replaced November 12, 1902, by a new gage, which was installed on the left bank 150 feet above the railroad bridge, its zero having the same elevation as that of the original gage. April 3, 1903, another new gage was established, consisting of a 4 by 4 inch vertical timber located on the left bank and having the same datum as the previous gages. June 23, 1903, this gage was torn out and moved 3 feet farther into the river, in order to place it in deeper water, and the zero of the gage was lowered 2.72 feet. The bench mark is the head of a bolt set in the concrete of the upstream side of the left abutment of the Southern Pacific Railroad bridge, 300 feet from the gage: elevation above zero of gage, 19.74 feet. February 21, 1904, the gage rod was washed out by a flood. A new gage was established in the same position as the old gage, but with its zero 1.54 feet above that of the old gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; WS = Water-Supply Paper):

Description: WS 38, pp 331-332; 51, p 404; 66, p 113; 85, pp 117-118; 100, pp 185-186; 133, p 301.
Discharge: WS 38, p 332; 51, p 404; 66, p 113; 85, p 118; 100, p 186; 133, pp 301-302.
Discharge, monthly: Ann 11, ii, p 102; 12, ii, p 351; 13, iii, p 95; 22, iv, p 405; WS 75, p 186; 85, p 119; 100, p 187; 133, p 303.
Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 59.
Gage heights: WS 38, p 332; 51, p 405; 66, p 114; 85, p 118; 100, pp 186-187; 133, p 302.
Hydrographs: Ann 12, ii, p 324; 22, iv, p 405; WS 75, p 186.
Rating tables: WS 52, p 521; 66, p 175; 85, p 119; 100, p 187; 133, p 303.

*Discharge measurements of Truckee River at Vista, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 6 | W. A. Wolf | 117 | 518 | 1.98 | 5.25 | 1,027 |
| April 13 | do | 115 | 480 | 1.70 | 5.00 | 816 |
| April 28 | do | 117 | 593 | 2.86 | 6.28 | 1,698 |
| May 25 | do | 117 | 563 | 2.45 | 5.85 | 1,381 |
| June 14 | do | 118 | 510 | 1.98 | 5.30 | 1,009 |
| June 22 | do | 114 | 368 | 1.04 | 4.07 | 381 |
| July 5 | do | 114 | 368 | 1.07 | 4.10 | 394 |
| July 17 | do | 113 | 327 | .70 | 3.55 | 221 |
| September 16 | do | 113 | 337 | .79 | 3.70 | 266 |

*Daily gage height, in feet, of Truckee River at Vista, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.6 | 4.8 | 5.8 | ....... | 5.6 | 5.7 | 4.1 | 3.4 | 3.4 | 4.0 | 4.3 | 4.3 |
| 2 | 5.4 | 5.1 | 5.8 | 5.0 | 5.8 | 5.6 | 4.1 | 3.4 | 3.5 | 4.0 | 4.3 | 4.4 |
| 3 | 5.4 | 5.9 | 5.9 | 5.0 | 6.0 | 5.4 | 4.1 | 3.4 | 3.5 | 4.0 | 4.1 | 4.4 |
| 4 | 5.4 | 4.8 | 5.9 | 4.9 | 6.2 | 5.7 | 4.1 | 3.4 | 3.5 | 4.0 | 4.1 | 4.4 |
| 5 | 5.3 | 4.8 | 6.0 | 5.3 | 5.8 | 5.6 | 4.1 | 3.4 | 3.5 | 4.0 | 4.1 | 4.4 |
| 6 | 5.3 | 4.8 | 6.0 | 5.4 | 5.6 | 5.3 | 4.1 | 3.4 | 3.6 | 4.0 | 4.2 | 4.4 |
| 7 | 5.2 | 4.8 | 6.0 | 5.5 | 5.5 | 5.3 | 4.0 | 3.4 | 3.6 | 4.1 | 4.2 | 4.4 |
| 8 | 5.2 | 4.8 | 6.0 | 5.5 | 5.5 | 5.2 | 3.9 | 3.4 | 3.7 | 4.1 | 4.2 | 4.4 |
| 9 | 5.2 | 4.7 | 6.0 | 5.3 | 5.5 | 5.3 | 3.9 | 3.4 | 3.7 | 4.1 | 4.2 | 4.4 |
| 10 | 5.1 | 4.9 | 5.8 | 5.5 | 5.5 | 5.6 | 3.8 | 3.4 | 3.7 | 4.1 | 4.2 | 4.0 |
| 11 | 5.1 | 4.8 | 5.9 | 5.4 | 5.3 | 5.3 | 3.7 | 3.4 | 3.7 | 4.2 | 4.3 | 4.2 |
| 12 | 5.1 | 4.8 | 5.9 | 5.2 | 5.2 | 5.5 | 3.7 | 3.4 | 3.7 | 4.2 | 4.3 | 4.1 |
| 13 | 5.0 | 4.8 | 6.1 | 5.0 | 5.0 | 5.6 | 3.7 | 3.4 | 3.7 | 4.2 | 4.3 | 4.1 |
| 14 | 5.0 | 4.9 | 6.0 | 5.0 | 4.8 | 5.6 | 3.5 | 3.4 | 3.7 | 4.2 | 4.3 | 4.2 |
| 15 | 5.0 | 4.9 | 5.8 | 5.1 | 5.6 | 5.4 | 3.5 | 3.5 | 3.7 | 4.2 | 4.2 | 4.1 |
| 16 | 4.9 | 5.0 | 6.5 | 5.0 | 5.7 | 5.4 | 3.5 | 3.5 | 3.7 | 4.2 | 4.2 | 4.1 |
| 17 | 5.8 | 4.9 | 5.5 | 4.9 | 5.3 | 5.3 | 3.4 | 3.5 | 3.7 | 4.2 | 4.2 | 4.1 |
| 18 | 4.8 | 4.9 | 5.5 | 4.8 | 5.4 | 5.3 | 3.4 | 3.6 | 3.7 | 4.2 | 4.2 | 4.1 |
| 19 | 4.7 | 5.0 | 5.5 | 4.8 | 6.3 | 5.3 | 3.4 | 3.6 | 3.7 | 4.2 | 4.2 | 4.1 |
| 20 | 4.8 | 5.5 | 5.5 | 4.9 | 6.2 | 5.0 | 3.4 | 3.6 | 3.7 | 4.2 | 4.3 | 4.1 |
| 21 | 5.2 | 5.3 | 5.5 | 5.0 | 6.2 | 5.0 | 3.4 | 3.6 | 3.7 | 4.2 | 4.3 | 4.0 |
| 22 | 5.3 | 5.4 | 5.5 | 4.5 | 6.0 | 4.8 | 3.4 | 3.7 | 3.7 | 4.2 | 4.4 | 3.7 |
| 23 | 5.0 | 5.4 | 5.3 | 4.7 | 5.8 | 4.8 | 3.4 | 3.7 | 3.8 | 4.2 | 4.4 | 3.7 |
| 24 | 5.0 | 5.9 | 5.3 | 4.5 | 5.7 | 4.4 | 3.4 | 3.7 | 3.8 | 4.3 | 4.3 | 3.1 |
| 25 | 4.9 | 5.8 | 5.0 | 4.5 | 6.0 | 4.6 | 3.2 | 3.7 | 3.9 | 4.3 | 4.2 | 3.9 |
| 26 | 4.8 | 5.8 | 5.0 | 6.0 | 5.9 | 4.6 | 3.2 | 3.7 | 3.9 | 4.3 | 4.2 | 4.2 |
| 27 | 4.8 | 5.8 | 5.5 | 6.5 | 5.7 | 4.4 | 3.3 | 3.7 | 3.9 | 4.2 | 4.2 | 4.1 |
| 28 | 4.7 | 5.8 | 5.4 | 6.3 | 5.8 | 4.2 | 3.4 | 3.6 | 3.9 | 4.2 | 4.2 | 4.1 |
| 29 | 4.8 | ....... | 5.4 | 6.2 | 5.7 | 4.0 | 3.4 | 3.6 | 4.0 | 4.2 | 4.2 | 4.1 |
| 30 | 4.7 | ....... | 4.9 | 6.2 | 5.7 | 4.0 | 3.4 | 3.5 | 4.0 | 4.2 | 4.3 | 4.1 |
| 31 | 4.7 | ....... | ....... | ....... | 5.8 | ....... | 3.4 | 3.5 | ....... | 4.3 | ....... | 4.1 |

*Station rating table for Truckee River at Vista, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 150 | 4.10 | 405 | 5.00 | 850 | 5.80 | 1,350 |
| 3.30 | 171 | 4.20 | 445 | 5.10 | 910 | 5.90 | 1,420 |
| 3.40 | 195 | 4.30 | 485 | 5.20 | 970 | 6.00 | 1,490 |
| 3.50 | 220 | 4.40 | 525 | 5.30 | 1,030 | 6.10 | 1,560 |
| 3.60 | 245 | 4.50 | 570 | 5.40 | 1,090 | 6.20 | 1,635 |
| 3.70 | 275 | 4.60 | 620 | 5.50 | 1,155 | 6.30 | 1,710 |
| 3.80 | 305 | 4.70 | 675 | 5.60 | 1,220 | 6.40 | 1,785 |
| 3.90 | 335 | 4.80 | 730 | 5.70 | 1,285 | 6.50 | 1,860 |
| 4.00 | 370 | 4.90 | 790 | | | | |

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 3.5 feet and 6.3 feet.

*Estimated monthly discharge of Truckee River at Vista, Nev., for 1905.*

[Drainage area, 1,519 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,220 | 675 | 894 | 54,970 | 0.589 | 0.679 |
| February | 1,420 | 675 | 943 | 52,370 | .621 | .647 |
| March | 1,560 | 790 | 1,237 | 76,060 | .814 | .938 |
| April | 1,860 | 570 | 1,003 | 59,680 | .660 | .736 |
| May | 1,710 | 730 | 1,279 | 78,640 | .842 | .971 |
| June | 1,285 | 370 | 930 | 55,340 | .612 | .683 |
| July | 405 | 150 | 260 | 15,990 | .171 | .197 |
| August | 275 | 195 | 224 | 13,770 | .147 | .170 |
| September | 370 | 195 | 279 | 16,600 | .184 | .205 |
| October | 485 | 370 | 430 | 26,440 | .283 | .326 |
| November | 525 | 405 | 460 | 27,370 | .303 | .338 |
| December | 525 | 130 | 421 | 25,890 | .277 | .319 |
| The year | 1,860 | 130 | 697 | 503,100 | .459 | 6.21 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

## TRUCKEE RIVER AT NEVADA-CALIFORNIA STATE LINE.

This station was established September 7, 1899. It is located at the State line, 17 miles west of Reno, Nev.

The channel is straight for 60 feet above and 75 feet below the cable. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of bowlders and cobblestones. The current is swift.

Discharge measurements are made by means of a cable and car, 2½ miles below the gage at Linham Siding and 100 feet below bridge No. 2. The initial point for soundings is the zero of the tagged wire.

The gage was read once each day during 1905 by H. E. Dickinson. The original gage was vertical, driven into the bed of the river and wired to a granite bowlder. November 11, 1902, a new gage was established on the right bank, 400 feet below the point at which the old gage was located. The new gage consists of two sections of 4 by 4 inch timber. The upper section is vertical and is spiked to a cottonwood tree; the lower section is inclined and is immediately under the vertical section. The gage datum is the same as that of the old gage. The bench mark consists of two spikes driven into the root of the cottonwood tree to which the vertical section of the gage is attached; elevation above zero of gage, 5.99 feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 38, p 331; 51, p 403; 66, p 112; 85, pp 119–120; 100, pp 192–193; 133, p 304.
Discharge: WS 38, p 331; 51, p 403; 66, p 112; 85, p 120; 100, p 193; 133, p 304.
Discharge, monthly: Ann 22, iv, p 404; WS 75, p 185; 85, p 121; 100, p 194; 133, p 306.
Gage heights: WS 38, p 331; 51, p 404; 66, p 113; 85, p 120; 100, pp 193–194; 133, p 305.
Hydrograph: Ann 22, iv, p 404.
Rating tables: WS 52, p 521; 66, p 175; 85, p 120; 100, p 194; 133, p 306.

*Discharge measurements of Truckee River at Nevada-California State line in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 17 | W. A. Wolf | 80 | 344 | 2.76 | 2.85 | 949 |
| May 13 | ....do | 80 | 370 | 2.91 | 2.95 | 1,078 |
| May 26 | ....do | 87 | 441 | 4.00 | 3.65 | 1,761 |
| June 6 | ....do | 81 | 378 | 3.10 | 3.08 | 1,170 |
| June 21 | ....do | 80 | 340 | 2.66 | 2.80 | 905 |
| July 10 | ....do | 80 | 300 | 1.93 | 2.25 | 580 |
| July 18 | ....do | 76 | 277 | 1.97 | 2.15 | 544 |
| July 25 | ....do | 76 | 277 | 1.95 | 2.12 | 539 |
| September 13 | ....do | 74 | 274 | 1.52 | 1.97 | 416 |

*Daily gage height, in feet, of Truckee River at Nevada-California State line for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 2.3 | 3.3 | 2.4 | 3.45 | 3.3 | 2.3 | 2.0 | 2.05 | 2.02 | 2.02 | 1.95 |
| 2 | 2.8 | 2.3 | 3.3 | ....... | 3.35 | 3.25 | 2.35 | 2.07 | 2.1 | 2.02 | 1.9 | 1.9 |
| 3 | 2.8 | 2.3 | 3.3 | 2.6 | 3.25 | 3.25 | 2.35 | 2.1 | 2.05 | 2.05 | 1.95 | 1.87 |
| 4 | 2.8 | 2.3 | 3.3 | 2.6 | 3.2 | 3.08 | 2.32 | 2.07 | 2.1 | 2.05 | 2.0 | 1.9 |
| 5 | 2.7 | 2.28 | 3.3 | 2.7 | 3.15 | 3.05 | 2.35 | 2.5 | 2.1 | 2.05 | 1.95 | 1.8 |
| 6 | 2.7 | 2.3 | 3.3 | 2.85 | 3.08 | 3.25 | 2.32 | 2.15 | 2.05 | 2.15 | 1.97 | 1.8 |
| 7 | 2.7 | 2.3 | 3.3 | 2.9 | 3.3 | 3.05 | 2.3 | 2.1 | 2.1 | 2.1 | 1.85 | 1.9 |
| 8 | ....... | 2.3 | 3.3 | 2.88 | 3.05 | 3.05 | 2.3 | 2.1 | 2.1 | 2.05 | 1.9 | 1.9 |
| 9 | 2.65 | 2.3 | 3.3 | ....... | 3.0 | 3.05 | 2.25 | 2.1 | 2.1 | 2.1 | 1.95 | 1.9 |
| 10 | 2.7 | 2.35 | 3.2 | 3.25 | 2.95 | 3.35 | 2.2 | 2.1 | 2.1 | 2.1 | 1.95 | 1.9 |
| 11 | 2.6 | 2.3 | 3.2 | 2.85 | 2.95 | 3.3 | 2.2 | 2.1 | 2.05 | 2.2 | 1.95 | 1.9 |
| 12 | 2.6 | 2.35 | 3.2 | 2.8 | 2.9 | 3.3 | 2.1 | 2.18 | 2.05 | 2.15 | 1.87 | 1.85 |
| 13 | 2.6 | 2.25 | 3.2 | 2.8 | 2.9 | 3.25 | 2.1 | 2.15 | 2.05 | 2.1 | 1.95 | 1.92 |
| 14 | 2.2 | 2.25 | 3.25 | 2.8 | 2.98 | 3.17 | 2.25 | 2.1 | 2.05 | 2.1 | 1.7 | 1.87 |
| 15 | 2.4 | 2.3 | 3.25 | 2.85 | 3.45 | 3.2 | 2.25 | 2.1 | 2.02 | 2.05 | 1.7 | 1.97 |
| 16 | 2.4 | 2.35 | 2.7 | 2.85 | 3.65 | ....... | 2.25 | 2.12 | 2.0 | 2.05 | 1.85 | 1.87 |
| 17 | 2.2 | 2.4 | 2.7 | 2.85 | 3.95 | 3.22 | 2.18 | 2.1 | 2.05 | 2.05 | 1.98 | 1.9 |
| 18 | 2.2 | 2.47 | 2.75 | 2.85 | 3.7 | 3.08 | 2.15 | 2.15 | 2.05 | 2.05 | 1.97 | 1.77 |
| 19 | 2.2 | 2.4 | 2.75 | 2.82 | 3.75 | 3.05 | 2.15 | 2.1 | 2.15 | 2.05 | 1.8 | 1.8 |
| 20 | 2.2 | 2.65 | 2.78 | ....... | 3.75 | 3.0 | 2.02 | 2.1 | 2.1 | 2.05 | 1.95 | 1.8 |
| 21 | 2.6 | 2.45 | 2.8 | 2.65 | 3.7 | 2.8 | 2.15 | 2.15 | 2.05 | 2.1 | 1.97 | 1.7 |
| 22 | 2.7 | 2.85 | 2.8 | 2.65 | 3.7 | 2.8 | 2.15 | 2.15 | 2.05 | 2.05 | 2.0 | 1.7 |
| 23 | 2.5 | 2.62 | 2.6 | 2.7 | 3.65 | 2.75 | 2.15 | 2.12 | 2.05 | 2.05 | 1.97 | 1.8 |
| 24 | 2.5 | 3.02 | 2.45 | 2.9 | 3.65 | 2.6 | 2.15 | 2.1 | 2.05 | 2.2 | 2.0 | 1.8 |
| 25 | 2.32 | 3.02 | 2.4 | 3.1 | 3.5 | 2.6 | 2.1 | 2.1 | 2.05 | 2.0 | 1.95 | 1.8 |
| 26 | 2.32 | 3.08 | 2.95 | 4.02 | 3.4 | 2.5 | 2.1 | 2.02 | 2.05 | 2.02 | 1.9 | 1.82 |
| 27 | 2.3 | 3.12 | 2.95 | 3.8 | 3.3 | 2.45 | 2.1 | 2.05 | 2.05 | 2.0 | 1.85 | 1.82 |
| 28 | 2.5 | 3.05 | 2.5 | 3.8 | 3.35 | 2.4 | 2.1 | 2.1 | 2.05 | 2.02 | 1.9 | 1.8 |
| 29 | ....... | ....... | 2.3 | 3.72 | 3.38 | 2.38 | 2.1 | 2.05 | 2.05 | 2.02 | 1.95 | 1.82 |
| 30 | 2.4 | ....... | 2.4 | ....... | 3.4 | 2.35 | 2.1 | 2.1 | 2.05 | 2.0 | 1.95 | 1.78 |
| 31 | 2.3 | ....... | 2.4 | ....... | 3.3 | ....... | 2.0 | 2.02 | ....... | 2.5 | ....... | 1.75 |

*Station rating table for Truckee River at Nevada-California State line from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 300 | 2.30 | 610 | 2.90 | 1,042 | 3.50 | 1,580 |
| 1.80 | 346 | 2.40 | 673 | 3.00 | 1,126 | 3.60 | 1,676 |
| 1.90 | 394 | 2.50 | 740 | 3.10 | 1,213 | 3.70 | 1,772 |
| 2.00 | 444 | 2.60 | 810 | 3.20 | 1,302 | 3.80 | 1,870 |
| 2.10 | 496 | 2.70 | 884 | 3.30 | 1,393 | 3.90 | 1,970 |
| 2.20 | 551 | 2.80 | 961 | 3.40 | 1,486 | 4.00 | 2,070 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined. Above gage height 3 feet it is the same as 1904 table.

*Estimated monthly discharge of Truckee River at Nevada-California State line for 1905.*

[Drainage area, 955 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 961 | 551 | 755 | 46,420 | 0.791 | 0.912 |
| February | 1,228 | 580 | 754 | 41,880 | .789 | .822 |
| March | 1,393 | 610 | 1,096 | 67,390 | 1.15 | 1.33 |
| April | 2,090 | 673 | 1,114 | 66,290 | 1.17 | 1.30 |
| May | 2,020 | 1,042 | 1,453 | 89,340 | 1.52 | 1.75 |
| June | 1,439 | 642 | 1,115 | 66,350 | 1.17 | 1.30 |
| July | 642 | 444 | 548 | 33,700 | .574 | .662 |
| August | 540 | 444 | 503 | 30,930 | .527 | .608 |
| September | 524 | 444 | 477 | 28,380 | .499 | .557 |
| October | 551 | 444 | 487 | 29,940 | .510 | .588 |
| November | 454 | 300 | 405 | 24,100 | .424 | .473 |
| December | 429 | 300 | 366 | 22,500 | .383 | .442 |
| The year | 2,090 | 300 | 756 | 547,200 | .792 | 10.74 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

## TRUCKEE RIVER AT TAHOE, CAL.

This station was established June 17, 1900, with a view to ascertaining the actual overflow from Lake Tahoe and the real value of the lake as a storage reservoir. It is located at the city of Tahoe. About 500 feet from the lake there is a timber dam across the river, which has been maintained for more than twenty years for the purpose of controlling the discharge from the lake.

The channel is nearly straight for 300 feet above and below the station. At the point of measurement the right bank is low and is subject to overflow at very high stages of the stream; the left bank is rather high. The bed of the stream, which is of gravel and coarse sand, is smooth and stable. The current has a moderate velocity.

Discharge measurements are made from a cable and suspended car about one-fourth mile below the gage. In June, 1904, a new cable was put in 1 mile below the gage.

The gage, which is read once each day by J. U. Haley, is located about 300 feet below the dam, as near the city of Tahoe as possible, for the convenience of the observer. It consists of a vertical timber driven into the stream bed and spiked to the root of a cottonwood tree growing on the bank. November 18, 1902, a new gage was established in the exact position of the old gage and with its zero at the same elevation. It is a 4 by 4 inch vertical timber. The bench mark is cut in the side of the tree and is 4.00 feet above gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 140, pp 210–211; WS 51, p 402; 66, p 111; 85, pp 115–116; 100, p 183; 133, p 307.
Discharge: Ann 11, ii, pp 64, 108; WS 51, p 402; 66, p 111; 85, p 116; 100, p 183; 133, p 307.
Discharge, monthly: Ann 22, iv, p 403; Bull 140, p 212; WS 75, p 184; 85, p 117; 100, p 185; 133, p 309.
Gage heights: Bull 140, p 211; WS 51, p 403; 66, p 112; 85, p 116; 100, p 184; 133, p 308.
Hydrograph: Ann 22, iv, p 403.
Rating tables: WS 52, p 520; 66, p 175; 85, p 117; 100, p 184; 133, p 308.

*Discharge measurements of Truckee River at Tahoe, Cal., in 1905.*

| Date | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 14 | W. A. Wolf | 20 | 15.2 | 1.01 | 0.30 | 15.4 |
| May 24 | do | 73 | 126 | 1.61 | 1.27 | 203 |
| June 13 | do | 72 | 125 | 1.61 | 1.30 | 211 |
| June 19 | do | 72 | 125 | 1.60 | 1.30 | 205 |
| July 26 | do | 79 | 168 | 1.95 | 1.80 | 328 |

*Daily gage height, in feet, of Truckee River at Tahoe, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | [a] 2.7 | [b] 1.6 | [a] 2.55 | 0.4 | 0.3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.8 | 1.7 |
| 2 | [a] 2.7 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.45 | 2.0 | 2.0 | 2.0 | 1.8 | 1.7 |
| 3 | [a] 2.7 | [b] 1.65 | [a] 2.55 | .4 | .3 | 1.3 | 1.45 | 2.0 | 2.0 | 2.0 | 1.8 | 1.7 |
| 4 | [a] 2.7 | [b] 1.65 | [a] 2.5 | .4 | .7 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.8 | 1.7 |
| 5 | [a] 2.7 | [b] 1.65 | [a] 2.5 | .4 | 1.0 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.7 | 1.7 |
| 6 | [a] 2.6 | [c] 1.65 | [a] 2.5 | .4 | 1.0 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.7 | 1.7 |
| 7 | [a] 2.6 | [c] 2.0 | [a] 2.5 | .4 | 1.25 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.7 | 1.7 |
| 8 | [a] 2.6 | [c] 2.0 | [a] 2.5 | .4 | 1.25 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.7 | 1.7 |
| 9 | [a] 2.6 | [c] 2.0 | [a] 2.5 | .4 | 1.25 | 1.3 | 1.5 | 1.95 | 2.0 | 2.1 | 1.7 | 1.6 |
| 10 | [a] 2.6 | [c] 2.0 | [a] 2.5 | .4 | 1.25 | 1.3 | 1.5 | 2.0 | 2.0 | 2.1 | 1.7 | 1.6 |
| 11 | [b] 1.6 | [c] 2.0 | [a] 2.5 | .4 | 1.25 | 1.3 | 1.5 | 2.0 | 1.9 | 2.1 | 1.7 | 1.6 |
| 12 | [b] 1.6 | [c] 2.0 | 2.5 | .3 | 1.25 | 1.3 | 1.5 | 2.0 | 1.9 | 2.1 | 1.7 | 1.6 |
| 13 | [b] 1.6 | [c] 2.0 | 2.5 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 1.9 | 2.0 | 1.7 | 1.6 |
| 14 | [b] 1.6 | [c] 2.0 | 2.5 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 1.9 | 2.0 | 1.7 | 1.6 |
| 15 | [b] 1.6 | [c] 2.0 | 1.6 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 1.9 | 2.0 | 1.7 | 1.6 |
| 16 | [b] 1.6 | [c] 2.0 | 1.6 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 1.9 | 2.0 | 1.7 | 1.6 |
| 17 | [b] 1.6 | [c] 2.0 | 1.6 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 1.9 | 2.0 | 1.7 | 1.5 |
| 18 | [b] 1.6 | [c] 2.0 | 1.6 | .3 | 1.25 | 1.3 | 1.6 | 2.0 | 2.0 | 2.0 | 1.7 | 1.5 |
| 19 | [b] 2.5 | [a] 2.55 | 1.6 | .3 | 1.25 | 1.3 | 1.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.5 |
| 20 | [b] 2.5 | [a] 2.55 | 1.15 | .3 | 1.25 | 1.3 | 1.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.5 |
| 21 | [b] 2.5 | [a] 2.55 | 1.15 | .3 | 1.25 | 1.3 | 1.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.5 |
| 22 | [b] 1.6 | [a] 2.55 | 1.15 | .3 | 1.25 | 1.3 | 1.9 | 2.0 | 2.0 | 1.9 | 1.7 | 1.5 |
| 23 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.3 | 1.9 | 2.0 | 2.0 | 1.9 | 1.7 | 1.5 |
| 24 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.35 | 1.9 | 2.0 | 2.0 | 1.9 | 1.7 | 1.5 |
| 25 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.35 | 1.9 | 2.0 | 2.0 | 1.9 | 1.7 | 1.5 |
| 26 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.6 | 1.5 |
| 27 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.6 | 1.5 |
| 28 | [b] 1.6 | [a] 2.55 | .4 | .3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.6 | 1.5 |
| 29 | [b] 1.6 | ....... | .4 | .3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.6 | 1.4 |
| 30 | [b] 1.6 | ....... | .4 | .3 | 1.3 | 1.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.6 | 1.4 |
| 31 | [b] 1.6 | ....... | .4 | ....... | 1.3 | ....... | 1.9 | 2.0 | ....... | 1.8 | ....... | 1.4 |

[a] All gates up.

[b] One gate up.

[c] Two gates up.

*Station rating table for Truckee River at Tahoe, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 15 | 1.00 | 139 | 1.60 | 279 | 2.20 | 453 |
| 0.40 | 31 | 1.10 | 160 | 1.70 | 306 | 2.30 | 485 |
| 0.50 | 47 | 1.20 | 182 | 1.80 | 334 | 2.40 | 518 |
| 0.60 | 64 | 1.30 | 205 | 1.90 | 363 | 2.50 | 552 |
| 0.70 | 82 | 1.40 | 229 | 2.00 | 392 | 2.60 | 586 |
| 0.80 | 100 | 1.50 | 253 | 2.10 | 422 | 2.70 | 622 |
| 0.90 | 119 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 and the form of previous curves. It is not well defined.

*Estimated monthly discharge of Truckee River at Tahoe, Cal., for 1905.*

[Drainage area, 519 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 622 | 279 | 410 | 25,210 | 0.790 | 0.911 |
| February | 569 | 279 | 433 | 24,050 | .834 | .868 |
| March | 569 | 31 | 321 | 19,740 | .618 | .712 |
| April | 31 | 15 | 20.9 | 1,244 | .040 | .045 |
| May | 205 | 15 | 173 | 10,640 | .333 | .384 |
| June | 241 | 205 | 212 | 12,620 | .408 | .455 |
| July | 363 | 241 | 303 | 18,630 | .584 | .673 |
| August | 392 | 363 | 391 | 24,040 | .753 | .868 |
| September | 392 | 363 | 385 | 22,910 | .742 | .828 |
| October | 422 | 334 | 390 | 23,980 | .751 | .866 |
| November | 334 | 279 | 305 | 18,150 | .588 | .656 |
| December | 306 | 229 | 271 | 16,660 | .522 | .602 |
| The year | 622 | 15 | 301 | 217,900 | .580 | 7.87 |

NOTE.—Ice conditions not known. Open-channel rating table applied to the winter months without correction.

## LAKE WINNEMUCCA INLET NEAR WADSWORTH, NEV.

This station was established November 7, 1902. It is located 3 miles north of Pyramid Lake Indian School and 21 miles north of Wadsworth, Nev.

The channel is straight for 150 feet above and below the cable. Both banks are high and not subject to overflow. The bed is composed of gravel and silt and may change slightly. There is but one channel at all stages. The current is moderate.

Discharge measurements are made by means of a cable and car near the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which was read three times each day during 1905 by Edward C. Wood, is a 4 by 4 inch vertical timber spiked to a willow tree on the right bank. The bench mark consists of two spikes driven into the tree to which the gage is attached; elevation above zero of gage, 6.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 190; 133, p 309.
Discharge: 100, p 191; 133, p 310.
Discharge, monthly: 100, p 192; 133, p 311.
Gage heights: 100, p 191; 133, p 310.
Rating table. 100, p 192; 133, p 311.

*Discharge measurements of Lake Winnemucca Inlet near Wadsworth, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 18 | W. A. Wolf | 46 | 118 | 1.66 | 3.30 | 196 |
| June 8 | do | 46 | 114 | 1.61 | 3.20 | 185 |
| July 11 | do | 46 | 85 | 1.75 | 2.75 | 149 |

*Daily gage height, in feet, of Lake Winnemucca Inlet near Wadsworth, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.88 | 2.21 | 2.27 | 2.21 | | | | | | 2.2 | 2.1 | |
| 2 | 2.77 | | | 2.21 | | 3.45 | 2.45 | 2.65 | 2.35 | | | 1.95 |
| 3 | | | 2.27 | | 3.15 | | | | 2.35 | | | 1.9 |
| 4 | 2.66 | 2.29 | | | | 3.25 | 2.35 | | | 2.2 | 2.1 | |
| 5 | | 2.27 | | 2.23 | | | | 2.55 | | | 2.0 | |
| 6 | 2.66 | | 2.3 | | 3.1 | | | 2.6 | 2.3 | 2.15 | | |
| 7 | | | | | 3.08 | 3.12 | | | | | | 1.8 |
| 8 | | 2.24 | | 2.24 | | 3.1 | 2.32 | 2.65 | | 2.2 | 1.9 | |
| 9 | 2.21 | | 2.29 | 2.24 | | | 2.6 | | 2.3 | | | 1.8 |
| 10 | | | | | 3.1 | 3.0 | | 2.65 | 2.3 | | 1.8 | 1.8 |
| 11 | 2.21 | 2.21 | 2.28 | | | 2.3 | | | | 2.3 | 1.75 | |
| 12 | | | 2.28 | 2.24 | | | 2.65 | 2.65 | | | 1.75 | |
| 13 | 2.22 | | | | 3.05 | | | 2.7 | 2.25 | | | 1.85 |
| 14 | | | | | 3.05 | 2.15 | | | | 2.3 | | |
| 15 | 2.0 | | | 2.22 | | | 2.75 | 2.75 | | 2.2 | | |
| 16 | 2.0 | 2.24 | 2.26 | 2.2 | | | 2.75 | | 2.3 | | 1.8 | 1.8 |
| 17 | | | | | 3.2 | 2.15 | | 2.7 | 2.3 | | | 2.2 |
| 18 | 2.0 | 2.25 | 2.2 | | | 2.2 | | | | 2.25 | 1.85 | |
| 19 | 2.22 | 2.24 | 2.24 | 2.18 | | | 2.7 | 2.75 | | | 1.9 | |
| 20 | 1.19 | | | | 3.25 | | | 2.5 | 2.25 | | | 2.1 |
| 21 | | | | | 3.25 | 2.1 | | | | 2.2 | | |
| 22 | 1.19 | 2.26 | 2.24 | 2.17 | | | 2.68 | | | 2.2 | 1.9 | |
| 23 | | | | 2.19 | | | 2.6 | 2.6 | 2.2 | | | 2.1 |
| 24 | | | | | 3.15 | 2.05 | | | 2.2 | | | 2.0 |
| 25 | 2.0 | 2.29 | 2.2 | 2.36 | | 2.9 | | | | 2.15 | 1.95 | |
| 26 | | 2.25 | 2.22 | | | | 2.6 | 2.6 | | | | |
| 27 | 2.0 | | | 2.58 | 3.5 | | | 2.5 | 2.3 | | | 2.0 |
| 28 | 2.0 | | | | 3.45 | 2.65 | | | | 2.1 | | |
| 29 | | | 2.23 | 2.55 | | | 2.58 | | | 2.15 | 1.9 | |
| 30 | 2.0 | | | 3.2 | | 2.55 | 2.6 | 2.5 | 2.2 | | | 2.1 |
| 31 | | | | | 3.45 | | | | | | | |

*Station rating table for Lake Winnemucca Inlet near Wadsworth, Nev., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 27 | 1.80 | 67 | 2.40 | 116 | 3.00 | 170 |
| 1.30 | 33 | 1.90 | 75 | 2.50 | 125 | 3.10 | 179 |
| 1.40 | 39 | 2.00 | 83 | 2.60 | 134 | 3.20 | 188 |
| 1.50 | 46 | 2.10 | 91 | 2.70 | 143 | 3.30 | 197 |
| 1.60 | 53 | 2.20 | 99 | 2.80 | 152 | 3.40 | 206 |
| 1.70 | 60 | 2.30 | 107 | 2.90 | 161 | 3.50 | 216 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905 and the form of previous curves. It is not well defined.

*Estimated monthly discharge of Lake Winnemucca Inlet near Wadsworth, Nev., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 159 | 26 | 93.9 | 5,774 |
| February | 106 | 100 | 103 | 5,720 |
| March | 107 | 99 | 103 | 6,333 |
| April | 188 | 97 | 107 | 6,367 |
| May | 216 | 174 | 189 | 11,620 |
| June | 211 | 87 | 136 | 8,093 |
| July | 148 | 109 | 132 | 8,116 |
| August | 148 | 121 | 135 | 8,301 |
| September | 116 | 99 | 105 | 6,248 |
| October | 107 | 91 | 99.0 | 6,087 |
| November | 91 | 64 | 75.5 | 4,493 |
| December | 99 | 67 | 79.6 | 4,894 |
| The year | 216 | 26 | 113 | 82,040 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction. Discharge interpolated on days when gage was not read.

## LITTLE TRUCKEE RIVER AT PINE STATION, CAL.

Little Truckee River rises on the eastern slope of the Sierra Nevada Mountains, in northwestern Nevada County, Cal., flows north, then east, and then south, and unites with the Truckee at the town of Boca, Cal.

The station was established June 25, 1903. The cable station is located about one-fourth mile upstream from Bruhn's mill, known also as Pine station. The road which follows the Little Truckee north from Boca crosses the river at a ford about 150 feet below the cable and the same distance above the gage rod. Pine station, on the Boca and Loyalton Railroad, about one-fourth of a mile distant, is the nearest railroad point.

Above the station the channel is straight for 100 feet at high water and for 30 feet at low water; below the station it is straight for 200 feet at high and low water. The right (south) bank is high, steep, and rocky and is not subject to overflow. It supports some underbrush and a few trees. The left (north) bank is composed of gravel for 40 feet back from the high-water channel, is low, and may be overflowed. The bed of the stream consists of course gravel and is free from vegetation. There is but one channel at all stages. The current is swift.

Discharge measurements are made from a wooden car running on a three-eighth-inch steel cable which is stretched across the river about 5½ feet above the high-water level. A tag wire is stretched just above the cable. The initial point for sounding is the post which supports the cable on the left bank.

The gage, which is read twice each day by S. Wallace, is located about 300 feet below the cable, and consists of a vertical 2 by 6 inch board. The bench mark is the head of a large nail driven into a 2 by 4 inch timber set in the ground in a clump of small willows 8 feet from the gage; willows surrounding the bench mark are blazed and marked "B. M., U. S. G. S."; elevation of bench mark above zero of gage, 4.83 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p. 195; 133, p 312.
Discharge: 100, p 195; 133, p 313.
Discharge, monthly: 100, p 197; 133, p 314.
Gage heights: 100, p 196; 133, p 313.
Rating table: 100, p 196; 133, p 314.

*Discharge measurements of Little Truckee River at Pine Station, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 16 | W. A. Wolf | 66 | 104 | 2.78 | 1.85 | 289 |
| May 11 | do | 66 | 101 | 2.71 | 1.80 | 274 |
| May 27 | do | 67 | 126 | 2.90 | 2.05 | 366 |
| June 7 | do | 68 | 109 | 3.15 | 2.00 | 343 |
| June 23 | do | 60 | 75 | 1.84 | 1.36 | 138 |
| July 8 | do | 54 | 58 | 1.70 | 1.12 | 98 |
| July 24 | do | 52 | 51 | 1.59 | 1.03 | 81 |

*Daily gage height, in feet, of Little Truckee River at Pine Station, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.28 | 1.13 | 1.36 | 1.53 | 2.49 | 2.26 | 1.28 | 0.75 | 0.58 | 0.7 | 0.71 | 1.12 |
| 2 | 1.25 | 1.19 | 1.44 | 1.6 | 2.5 | 2.22 | 1.4 | .75 | .6 | .7 | .71 | 1.2 |
| 3 | 1.24 | 1.09 | 1.43 | 1.64 | 2.59 | 2.14 | 1.4 | .73 | .58 | .7 | .7 | 1.13 |
| 4 | 1.0 | 1.04 | 1.46 | 1.65 | 2.43 | 2.09 | 1.38 | .73 | .6 | .7 | .71 | 1.1 |
| 5 | 0.99 | 1.0 | 1.54 | 1.75 | 2.29 | 1.99 | 1.32 | .72 | .6 | .68 | .66 | 1.15 |
| 6 | 1.14 | 1.0 | 1.59 | 1.76 | 2.22 | 1.97 | 1.22 | .7 | .6 | .68 | .65 | 1.18 |
| 7 | 1.16 | 1.0 | 1.6 | 1.83 | 2.24 | 1.96 | 1.18 | .7 | .6 | .68 | .71 | 1.2 |
| 8 | 1.14 | .82 | 1.62 | 1.84 | 2.15 | 2.04 | 1.18 | .7 | .6 | .7 | .69 | 1.13 |
| 9 | 1.06 | .86 | 1.6 | 1.85 | 2.12 | 2.12 | 1.14 | .68 | .6 | .7 | .67 | 1.15 |
| 10 | 1.12 | .94 | 1.59 | 1.84 | 1.99 | 2.16 | 1.12 | .68 | .61 | .7 | .67 | 1.13 |
| 11 | 1.1 | 1.02 | 1.6 | 1.78 | 1.95 | 2.21 | 1.1 | .68 | .6 | .68 | .71 | 1.26 |
| 12 | 1.06 | .94 | 1.56 | 1.94 | 1.9 | 2.3 | 1.04 | .7 | .61 | .68 | .82 | 1.23 |
| 13 | 1.01 | 1.0 | 1.68 | 1.74 | 1.99 | 2.26 | 1.04 | .7 | .61 | .68 | .8 | 1.3 |
| 14 | 1.08 | 1.0 | 1.58 | 1.76 | 2.12 | 2.19 | 1.1 | .7 | .61 | .68 | .81 | 1.3 |
| 15 | 1.25 | 1.02 | 1.53 | 1.85 | 2.1 | 2.16 | 1.1 | .68 | .6 | .68 | .79 | 1.3 |
| 16 | 1.25 | 1.06 | 1.55 | 1.8 | 2.35 | 2.14 | 1.06 | .65 | .6 | .69 | .83 | 1.25 |
| 17 | 1.25 | 1.04 | 1.56 | 1.72 | 2.62 | 2.16 | 0.98 | .65 | .62 | .67 | .83 | 1.18 |
| 18 | 1.19 | 1.02 | 1.5 | 1.82 | 2.58 | 2.03 | .93 | .65 | .63 | .7 | .81 | 1.23 |
| 19 | 1.12 | 1.1 | 1.52 | 1.7 | 2.5 | 1.99 | .9 | .64 | .63 | .69 | .79 | 1.2 |
| 20 | 1.13 | 1.18 | 1.56 | 1.63 | 2.5 | 1.98 | .9 | .63 | .63 | .69 | .81 | 1.2 |
| 21 | 1.06 | 1.05 | 1.56 | 1.62 | 2.52 | 1.93 | .9 | .66 | .63 | .69 | .83 | 1.0 |
| 22 | 1.11 | 1.05 | 1.48 | 1.62 | 2.44 | 1.8 | .86 | .7 | .63 | .69 | .9 | 1.2 |
| 23 | 1.26 | 1.06 | 1.51 | 1.69 | 2.25 | 1.76 | .85 | .7 | .63 | .69 | .87 | 1.15 |
| 24 | 1.29 | 1.14 | 1.58 | 1.8 | 2.29 | 1.72 | 1.02 | .65 | .64 | .69 | .79 | 1.2 |
| 25 | 1.23 | 1.24 | 1.56 | 2.46 | 2.26 | 1.66 | .9 | .65 | .65 | .7 | .74 | 1.25 |
| 26 | 1.3 | 1.28 | 1.82 | 2.74 | 2.36 | 1.65 | .88 | .63 | .65 | .7 | .73 | 1.3 |
| 27 | 1.26 | 1.32 | 1.62 | 2.69 | 2.12 | 1.66 | .82 | .62 | .65 | .7 | .83 | 1.25 |
| 28 | 1.14 | 1.38 | 1.54 | 2.72 | 2.24 | 1.34 | .8 | .6 | .69 | .7 | 1.0 | 1.12 |
| 29 | 1.13 | ...... | 1.43 | 2.85 | 2.2 | 1.3 | .8 | .6 | .7 | .7 | 1.2 | 1.15 |
| 30 | 1.06 | ...... | 1.52 | 2.59 | 2.22 | 1.28 | .8 | .6 | .73 | .7 | 1.12 | ...... |
| 31 | 1.14 | ...... | 1.49 | ...... | 2.2 | ...... | .75 | .58 | ...... | .7 | ...... | 1.23 |

*Station rating table for Little Truckee River at Pine Station, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 35 | 1.20 | 107 | 1.80 | 270 | 2.40 | 531 |
| 0.70 | 45 | 1.30 | 126 | 1.90 | 307 | 2.50 | 580 |
| 0.80 | 55 | 1.40 | 148 | 2.00 | 347 | 2.60 | 630 |
| 0.90 | 66 | 1.50 | 174 | 2.10 | 390 | 2.70 | 681 |
| 1.00 | 78 | 1.60 | 203 | 2.20 | 436 | 2.80 | 733 |
| 1.10 | 91 | 1.70 | 235 | 2.30 | 483 | 2.90 | 786 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–5. It is well defined between gage heights 1 foot and 2.1 feet.

*Estimated monthly discharge of Little Truckee River at Pine Station, Cal., for 1905.*

[Drainage area, 166 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 126 | 77 | 101 | 6,210 | .608 | .701 |
| February | 144 | 57 | 89.0 | 4,943 | .536 | .558 |
| March | 277 | 139 | 188 | 11,560 | 1.13 | 1.30 |
| April | 760 | 183 | 334 | 19,870 | 2.01 | 2.24 |
| May | 640 | 307 | 477 | 29,330 | 2.87 | 3.31 |
| June | 483 | 122 | 337 | 20,050 | 2.03 | 2.26 |
| July | 148 | 50 | 86.3 | 5,306 | .520 | .600 |
| August | 50 | 33 | 42.1 | 2,589 | .254 | .293 |
| September | 48 | 33 | 37.4 | 2,226 | .225 | .251 |
| October | 45 | 42 | 44.2 | 2,718 | .266 | .307 |
| November | 107 | 40 | 55.4 | 3,296 | .334 | .373 |
| December | 126 | 78 | 106 | 6,518 | .637 | .734 |
| The year | 760 | 33 | 158 | 114,600 | .952 | 12.93 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

## INDEPENDENCE CREEK BELOW INDEPENDENCE LAKE, CAL.

Independence Creek flows from the east end of Independence Lake northeastward into Little Truckee River.

The gaging station was established October 24, 1902, It is located about one-eighth of a mile below the dam at the lower end of Independence Lake, Cal.

The channel is straight for 50 feet above and below the station. The banks are low and subject to overflow. The bed of the stream is permanent, being composed of gravel and clay, but during high water large quantities of sand are washed down the creek. The current is moderately rapid and the discharge is controlled by the dam at the end of the lake.

Discharge measurements are made from a cable and car.

The gage, which is read twice daily by William Schweinberger, consisted originally of a vertical 4 by 4 inch timber, located about 200 feet upstream from the cable. For the convenience of the observer a new vertical gage, made of 2 by 4 inch timber, was established July 1, 1904, on the left bank of the stream 75 feet below the outlet of the lake. Simultaneous readings taken on the two gages give identical results for the fluctuations of 1904. The bench mark for the original gage consists of three nails driven into the root of a pine tree 55 feet northwest of the gage; elevation above zero of gage, 5.82 feet. The bench mark for the new gage is the head of four nails driven into the tree stump to which the new gage rod is fastened; elevation above zero of new gage, 3.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 85, p 121; 100, p 197; 133, p 315.
**Discharge**: 85, p 122; 100 p 197; 133, p 315.
**Discharge, monthly**: 100, p 199; 133, p 317.
**Gage heights**: 85, p 122; 100, p 198; 133, p 316.
**Rating table**: 100, p 199; 133, p 317.

*Discharge measurements of Independence Creek below Independence Lake, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 12 | W. A. Wolf | 28 | 62 | 1.24 | 3.25 | 77 |
| June 26 | do | | 3 | 1.00 | 1.80 | 3 |
| July 7 | do | 11 | 9 | 1.67 | 2.30 | 15 |
| August 3 | do | 6 | 3 | 1.48 | 2.00 | 4.3 |
| September 11 | do | | | | 1.70 | [a] .5 |

[a] Estimated.

*Daily gage height, in feet, of Independence Creek below Independence Lake, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.1 | 2.7 | 2.5 | 2.7 | 3.28 | 3.2 | 1.88 | 2.0 | 1.65 | 1.5 | 1.5 | 2.18 |
| 2 | 2.1 | 2.58 | 2.5 | 2.7 | 3.5 | 3.2 | 2.0 | 2.0 | 1.65 | 1.5 | 1.5 | 2.15 |
| 3 | 2.15 | 2.4 | 2.5 | 2.45 | 3.5 | 3.1 | 2.1 | 2.0 | 1.65 | 1.5 | 1.45 | 2.12 |
| 4 | 2.15 | 2.3 | 2.5 | 2.25 | 3.5 | 3.1 | 2.2 | 2.0 | 1.65 | 1.5 | 1.45 | 2.1 |
| 5 | 2.15 | 2.2 | 2.5 | 2.25 | 3.5 | 3.1 | 2.25 | 2.0 | 1.65 | 1.5 | 1.45 | 2.3 |
| 6 | 2.18 | 2.2 | 2.5 | 2.25 | 3.35 | 3.1 | 2.3 | 2.0 | 1.65 | 1.5 | 1.45 | 2.5 |
| 7 | 2.2 | 2.2 | 2.5 | 2.25 | 3.15 | 3.05 | 2.3 | 1.95 | 1.65 | 1.5 | 1.45 | 2.25 |
| 8 | 2.2 | 2.2 | 2.5 | 2.28 | 3.1 | 3.08 | 2.3 | 1.95 | 1.65 | 1.5 | 1.45 | 2.0 |
| 9 | 2.2 | 2.2 | 2.5 | 2.3 | 3.05 | 3.1 | 2.3 | 1.95 | 1.65 | 1.5 | 1.45 | 2.0 |
| 10 | 2.2 | 2.2 | 2.5 | 2.3 | 3.15 | 3.15 | 2.25 | 1.95 | 1.65 | 1.5 | 1.38 | 1.98 |
| 11 | 2.22 | 2.2 | 2.5 | 2.3 | 2.7 | 3.18 | 2.25 | 1.9 | 1.65 | 1.5 | 2.35 | 1.95 |
| 12 | 2.25 | 2.2 | 2.5 | 2.3 | 2.7 | 3.2 | 2.25 | 1.9 | 1.6 | 1.5 | 2.3 | 1.95 |
| 13 | 2.32 | 2.2 | 2.5 | 2.3 | 2.7 | 3.2 | 2.2 | 1.9 | 1.6 | 1.5 | 2.25 | 1.92 |
| 14 | 2.52 | 2.22 | 2.5 | 2.3 | 2.7 | 3.2 | 2.18 | 1.9 | 1.6 | 1.5 | 2.2 | 1.9 |
| 15 | 2.6 | 2.25 | 2.5 | 2.3 | 2.7 | 3.22 | 2.1 | 1.9 | 1.6 | 1.5 | 2.2 | 1.88 |
| 16 | 2.6 | 2.25 | 2.5 | 2.3 | 2.7 | 3.22 | 2.1 | 1.85 | 1.6 | 1.5 | 2.15 | 1.88 |
| 17 | 2.6 | 2.25 | 2.5 | 2.3 | 2.88 | 3.2 | 2.1 | 1.85 | 1.55 | 1.5 | 2.15 | 1.85 |
| 18 | 2.62 | 2.25 | 2.5 | 2.65 | 3.08 | 3.2 | 2.05 | 1.85 | 1.55 | 1.5 | 2.1 | 1.85 |
| 19 | 2.65 | 2.38 | 2.5 | 3.05 | 3.08 | 3.2 | 2.05 | 1.85 | 1.55 | 1.5 | 2.1 | 1.9 |
| 20 | 2.68 | 2.48 | 2.6 | 3.05 | 3.28 | 3.2 | 2.05 | 1.85 | 1.55 | 1.5 | 2.15 | 1.9 |
| 21 | 2.88 | 2.5 | 2.7 | 3.05 | 3.45 | 3.15 | 2.08 | 1.85 | 1.55 | 1.5 | 2.1 | 1.9 |
| 22 | 2.98 | 2.5 | 2.7 | 3.2 | 3.45 | 3.15 | 2.1 | 1.85 | 1.55 | 1.5 | 2.1 | 1.85 |
| 23 | 2.98 | 2.5 | 2.7 | 3.1 | 3.45 | 3.15 | 2.15 | 1.85 | 1.55 | 1.5 | 2.1 | 1.85 |
| 24 | 3.02 | 2.5 | 2.7 | 3.1 | 3.0 | 3.1 | 2.2 | 1.8 | 1.55 | 1.5 | 2.5 | 1.82 |
| 25 | 3.12 | 2.5 | 2.8 | 3.1 | 2.55 | 3.08 | 2.2 | 1.75 | 1.55 | 1.5 | 2.5 | 1.84 |
| 26 | 3.25 | 2.5 | 2.72 | 3.1 | 2.55 | 2.4 | 2.15 | 1.75 | 1.55 | 1.5 | 2.25 | 1.8 |
| 27 | 3.25 | 2.5 | 2.75 | 3.1 | 2.55 | 1.8 | 2.1 | 1.7 | 1.55 | 1.5 | 2.12 | 1.85 |
| 28 | 3.08 | 2.5 | 2.75 | 3.1 | 3.05 | 1.8 | 2.1 | 1.7 | 1.5 | 1.5 | 2.15 | 1.85 |
| 29 | 2.85 | | 2.75 | 3.1 | 3.08 | 1.82 | 2.05 | 1.68 | 1.5 | 1.5 | 2.2 | 1.9 |
| 30 | 2.85 | | 2.75 | 3.1 | 3.18 | 1.88 | 2.05 | 1.65 | 1.5 | 1.5 | 2.2 | 1.9 |
| 31 | 2.85 | | 2.75 | | 3.2 | | 2.05 | 1.65 | | 1.5 | | 1.98 |

*Station rating table for Independence Creek below Independence Lake, Cal., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge | Gage height. | Discharge. | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 0.3 | 1.90 | 3.4 | 2.50 | 23 | 3.10 | 107 |
| 1.40 | .4 | 2.00 | 4.7 | 2.60 | 30 | 3.20 | 127 |
| 1.50 | .5 | 2.10 | 6.7 | 2.70 | 40 | 3.30 | 148 |
| 1.60 | .9 | 2.20 | 9.5 | 2.80 | 53 | 3.40 | 170 |
| 1.70 | 1.5 | 2.30 | 13 | 2.90 | 69 | 3.50 | 192 |
| 1.80 | 2.3 | 2.40 | 17 | 3.00 | 87 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 2 feet and 3.25 feet. Below 2 feet the table is rather uncertain.

*Estimated monthly discharge of Independence Creek below Independence Lake, Cal., for 1905.*

[Drainage area, 8.5 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 137 | 6.7 | 43.0 | 2,644 | 5.06 | 5.83 |
| February | 40 | 9.5 | 16.4 | 911 | 1.93 | 2.01 |
| March | 53 | 23 | 30.7 | 1,888 | 3.61 | 4.16 |
| April | 127 | 11 | 52.7 | 3,136 | 6.20 | 6.92 |
| May | 192 | 26 | 107 | 6,579 | 12.59 | 14.52 |
| June | 131 | 2.3 | 98.9 | 5,885 | 11.64 | 12.98 |
| July | 13 | 3.2 | 8.2 | 504 | .965 | 1.11 |
| August | 4.7 | 1.2 | 3.1 | 191 | .365 | .419 |
| September | 1.2 | .5 | .90 | 54 | .106 | .118 |
| October | .5 | .5 | .50 | 31 | .059 | .068 |
| November | 23 | .4 | 7.0 | 417 | .824 | .919 |
| December | 23 | 2.3 | 5.1 | 314 | .600 | .692 |
| The year | 192 | .4 | 31.1 | 22,550 | 3.66 | 49.75 |

NOTE.—Ice conditions not known; open-channel rating table applied to the winter months without correction.

## PROSSER CREEK NEAR HOBART MILLS, CAL.

Prosser Creek rises on the eastern slope of the Sierra Nevada in central Sierra County, Cal., flows in a general southeasterly direction, and unites with Truckee River near Prosser.

The station was established June 27, 1903. It is located about 150 feet below the wagon bridge and the road house on the Boca and Truckee highway, 4 miles from Truckee and 3 miles from Hobart Mills. Alder Creek joins Prosser Creek about 200 feet above the station. The nearest dam is located at the ice pond about 2 miles below the station.

The channel is straight for 150 feet above and 200 feet below the cable. The creek bends at the highway bridge. Both banks are high and are not subject to overflow. The right bank is wooded; the left is cleared except for a few willows. The bed is composed of coarse gravel and is free from vegetation. There is but one channel at all stages.

Discharge measurements are made from a wooden car running on a three-eighths inch steel cable, which is stretched across the river about 5 feet above high-water level. A tag wire is stretched just above the cable.

The original gage consisted of a 2 by 4 inch vertical timber. It was located on the left or north bank 50 feet upstream from the cable. The old gage, the zero of which was 9.87 feet below the bench mark, was washed out by a flood February 24, 1904. A new gage was established at the same point, with its zero 9.58 feet below the bench mark. The bench mark is on the northeast pier of the steel wagon bridge, and is the top of the steel casing of the concrete pier above the arrow mark.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 200-201; 133, p 318.
Discharge: 100, p 201; 133, p 318.
Discharge, monthly: 133, p 320.
Gage heights: 100, p 201; 133, p 319.
Rating table: 133, p 319.

*Discharge measurements of Prosser Creek near Hobart Mills, Cal., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 12 | W. A. Wolf | 57 | 2.22 | 2.05 | 129 |
| May 23 | do | 69 | 2.60 | 2.30 | 179 |
| June 12 | do | 68 | 2.43 | 2.25 | 165 |
| June 26 | do | 55 | 2.20 | 2.00 | 120 |
| July 7 | do | 55 | 1.91 | 1.90 | 101 |
| July 27 | do | | | 1.25 | 11 |

## DONNER CREEK NEAR TRUCKEE, CAL.

Donner Creek flows from the east end of Donner Lake eastward into Truckee River.

The gaging station was established October 23, 1902. It is located about 150 feet below the dam of the Donner Creek Ice Company and 1½ miles west of Truckee, Cal.

The channel is straight for 150 feet above and below the cable. Both banks are high and will not overflow. The bed of the stream is composed of gravel, is permanent, and is free from vegetation. There is but one channel at all stages and the current is swift.

Discharge measurements are made by means of a cable and car 50 feet downstream from the gage.

The gage, which is read twice each day by F. R. Williams, is a 4 by 4 inch vertical timber located on the left bank. The bench mark consists of four nails driven into the root of a pine tree 12 inches in diameter 35 feet north of the gage; elevation above zero of gage, 6.30 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 123; 100, p 202; 133, p 320.
Discharge: 51, p 405; 85, p 123; 100, p 202; 133, p 321.
Discharge, monthly: 100, p 204; 133, p 322.
Gage heights: 85, p 123; 100, pp 202-203; 133, p 321.
Rating table: 100, p 203; 133, p 322.

*Discharge measurements of Donner Creek near Truckee, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| April 15 | W. A. Wolf | 36 | 48 | 3.27 | 3.06 | 157 |
| May 12 | do | 36 | 48 | 3.25 | 3.01 | 156 |
| May 23 | do | 38 | 56 | 4.00 | 3.42 | 224 |
| June 26 | do | 20 | 17 | 2.18 | 2.12 | 37 |
| July 6 | do | 10 | 12 | 1.34 | 1.74 | 16.0 |
| July 27 | do | | | | 1.15 | 1.0 |
| August 2 | do | | | | .90 | .2 |
| September 9 | do | | | | 1.00 | .5 |

*Daily gage height, in feet, of Donner Creek near Truckee, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.9 | 1.7 | 3.0 | 2.7 | 3.6 | 3.3 | 1.9 | 1.1 | 1.0 | 1.0 | 0.65 | 2.2 |
| 2 | 1.9 | 1.8 | 3.0 | 2.6 | 3.5 | 3.2 | 1.9 | .95 | 2.25 | 1.0 | .75 | .0 |
| 3 | 1.9 | 1.8 | 3.0 | 2.6 | 3.45 | 3.15 | 1.9 | .9 | 2.2 | .95 | .8 | .0 |
| 4 | 1.7 | 1.8 | 3.0 | 2.65 | 3.4 | 3.05 | 1.85 | .9 | 1.1 | .95 | .8 | .0 |
| 5 | 1.7 | 1.8 | 3.05 | 2.75 | 3.35 | 3.0 | 1.8 | 1.0 | 1.2 | .95 | .8 | .0 |
| 6 | 1.7 | 1.8 | 3.1 | 2.8 | 3.3 | 3.0 | 1.75 | 1.05 | 1.15 | .5 | .85 | .9 |
| 7 | 1.7 | 1.8 | 3.1 | 2.8 | 3.3 | 3.0 | 1.7 | 1.0 | 1.0 | .45 | .9 | .9 |
| 8 | 1.7 | 1.7 | 3.0 | 2.9 | 3.3 | 3.0 | 1.7 | 1.0 | 1.0 | 1.0 | .9 | .9 |
| 9 | 1.7 | 1.7 | 3.0 | 3.0 | 3.25 | 3.0 | 1.65 | 1.0 | 1.0 | 1.5 | .9 | .9 |
| 10 | 1.6 | 1.7 | 3.0 | 3.1 | 3.15 | 3.0 | 1.6 | 1.0 | 1.0 | 1.6 | .9 | .9 |
| 11 | 1.6 | 1.7 | 3.0 | 3.0 | 3.1 | 3.0 | 1.55 | 1.0 | 1.0 | 1.75 | .9 | .9 |
| 12 | 1.6 | 1.9 | 3.0 | 3.1 | 3.05 | 3.0 | 1.55 | 1.0 | 1.0 | 1.6 | .9 | .9 |
| 13 | 1.6 | 2.2 | 3.0 | 3.1 | 3.0 | 2.95 | 1.5 | 1.0 | 1.0 | 1.8 | .9 | .9 |
| 14 | 1.9 | 2.[illegible] | 2.9 | 3.1 | 3.1 | 2.95 | 1.45 | 1.0 | 1.0 | 1.8 | .9 | .9 |
| 15 | 1.9 | 2.2 | 2.9 | 3.1 | 3.25 | 2.9 | 1.5 | 1.0 | 1.0 | 1.55 | .9 | .9 |
| 16 | 1.9 | 2.2 | 2.8 | 3.1 | 3.5 | 2.85 | 1.4 | 1.0 | 1.0 | 1.35 | 1.2 | .9 |
| 17 | 1.9 | 2.2 | 2.8 | 3.1 | 3.55 | 2.85 | 1.35 | 1.0 | 1.0 | 1.15 | 1.15 | .9 |
| 18 | 1.8 | 2.2 | 2.8 | 3.05 | 3.6 | 2.85 | 1.3 | 1.0 | 1.0 | 1.05 | .95 | .9 |
| 19 | 1.8 | 2.25 | 2.8 | 3.0 | 3.6 | 2.8 | 1.3 | 1.0 | 1.0 | 1.05 | .9 | .9 |
| 20 | 1.7 | 2.5 | 2.8 | 3.0 | 3.5 | 2.8 | 1.25 | 1.0 | 1.0 | 1.0 | .9 | .9 |
| 21 | 1.7 | 2.4 | 2.8 | 3.0 | 3.5 | 2.7 | 1.2 | 1.0 | 1.0 | 1.0 | .9 | .9 |
| 22 | 1.9 | 2.3 | 2.8 | 3.0 | 3.5 | 2.55 | 1.15 | 1.0 | 1.0 | 1.0 | .9 | .9 |
| 23 | 1.8 | 2.35 | 2.8 | 3.05 | 3.4 | 2.35 | 1.1 | 1.0 | 1.0 | 1.45 | .9 | .9 |
| 24 | 1.8 | 2.35 | 2.8 | 3.1 | 3.4 | 2.25 | 1.2 | 1.0 | 1.0 | 1.8 | .9 | .9 |
| 25 | 1.8 | 3.2 | 2.8 | 3.1 | 3.4 | 2.2 | 1.15 | 1.0 | 1.0 | 1.0 | .9 | .9 |
| 26 | 1.7 | 3.15 | 2.8 | 3.5 | 3.4 | 2.15 | 1.15 | 1.0 | 1.0 | .0 | .9 | .95 |
| 27 | 1.7 | 3.05 | 2.8 | 3.7 | 3.35 | 2.1 | 1.15 | 1.0 | 1.0 | .0 | .9 | 1.0 |
| 28 | 1.8 | 3.0 | 2.8 | 3.6 | 3.3 | 2.1 | 1.15 | 1.0 | 1.0 | .0 | .9 | 1.0 |
| 29 | 1.8 | ....... | 2.8 | 3.65 | 3.3 | 2.0 | 1.15 | 1.0 | 1.0 | .15 | .9 | 1.0 |
| 30 | 1.7 | ....... | 2.7 | 3.6 | 3.3 | 2.0 | 1.15 | 1.0 | 1.0 | .45 | .9 | 1.0 |
| 31 | 1.7 | ....... | 2.7 | ....... | 3.3 | ....... | 1.12 | 1.0 | ....... | .55 | ....... | 1.0 |

*Station rating table for Donner Creek near Truckee, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. | Gage height | Discharge |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet* | *Feet* | *Second-feet* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.70 | 0.0 | 1.50 | 8.3 | 2.30 | 52 | 3.10 | 166 |
| .80 | .1 | 1.60 | 11.5 | 2.40 | 62 | 3.20 | 185 |
| .90 | .2 | 1.70 | 15 | 2.50 | 73 | 3.30 | 206 |
| 1.00 | .5 | 1.80 | 19 | 2.60 | 86 | 3.40 | 227 |
| 1.10 | 1.1 | 1.90 | 24 | 2.70 | 100 | 3.50 | 248 |
| 1.20 | 2.0 | 2.00 | 29 | 2.80 | 115 | 3.60 | 269 |
| 1.30 | 3.5 | 2.10 | 35 | 2.90 | 131 | 3.70 | 290 |
| 1.40 | 5.7 | 2.20 | 43 | 3.00 | 148 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined.

*Estimated monthly discharge of Donner Creek near Truckee, Cal., for 1905.*

[Drainage area, 30 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 24 | 11.5 | 17.8 | 1,094 | 0.593 | 0.684 |
| February | 185 | 15 | 53.1 | 2,949 | 1.77 | 1.84 |
| March | 166 | 100 | 130 | 7,993 | 4.33 | 4.99 |
| April | 290 | 86 | 163 | 9,699 | 5.43 | 6.06 |
| May | 269 | 148 | 218 | 13,400 | 7.27 | 8.38 |
| June | 206 | 29 | 114 | 6,783 | 3.80 | 4.24 |
| July | 24 | 1.1 | 8.6 | 529 | .287 | .331 |
| August | 1.1 | .2 | .51 | 31 | .017 | .020 |
| September | 48 | .5 | 3.6 | 214 | .120 | .134 |
| October | 19 | 0 | 4.4 | 270 | .147 | .170 |
| November | 2 | 0 | .29 | 17 | .0097 | .011 |
| December | 43 | 0 | 1.6 | 98 | .053 | .061 |
| The year | 290 | 0 | 59.6 | 43,290 | 1.98 | 26.92 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## WALKER RIVER BASIN.

### DESCRIPTION OF BASIN.

Walker River is formed by two branches—East and West forks—which rise on the eastern slopes of the Sierra Nevada, in Mono County, Cal., flow in a general northerly direction, and unite in Lyon County, Nev. From the point of junction the main stream flows northward through Mason Valley, at the upper end of which it turns to the east and southeast and discharges into the north end of Walker Lake.

### WEST FORK OF WALKER RIVER NEAR COLEVILLE, CAL.

This station was established October 5, 1902. The cable is located about 1 mile east of the point where the main road from Topaz to Bridgeport crosses Lost Canyon Creek and is 600 feet from the road. The gage is about one-half mile above the cable.

The channel is straight for 150 feet above and below the station. The right bank is low and rocky and is liable to overflow; the left is high and rocky and will not overflow. The bed of the stream is rocky and uneven. There is but one channel at all stages and the current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by J. S. Trumbull, is a 4 by 4 inch vertical timber on the left bank, about 300 feet from the observer's house. The bench mark is a spike driven into the tree to which the gage is fastened; elevation above zero of gage, 6.00 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 108; 100, pp 172-173; 133, p 323.
Discharge: 85, p 108; 100, p 173; 133, p 323.
Discharge, monthly: 100, p 174; 133, p 325.
Gage heights: 85, p 108; 100, p 173; 133, p 324.
Rating table: 100, p 174; 133, p 324.

*Discharge measurements of West Fork of West Walker River near Coleville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 3 | J. L. Brambila | 51 | 109 | 3.20 | 2.50 | 349 |
| May 11 | do | 48 | 98 | 2.37 | 2.15 | 232 |
| May 24 | do | 55 | 165 | 5.13 | 3.45 | 846 |
| June 6 | do | 55 | 160 | 4.11 | 3.10 | 657 |
| June 29 | do | 55 | 160 | 4.35 | 3.20 | 694 |
| July 8 | do | 55 | 147 | 4.40 | 3.10 | 645 |
| July 24 | do | 47 | 99 | 2.04 | 2.00 | 202 |
| July 25 | do | 54 | 134 | 2.48 | 2.30 | 333 |
| August 30 | W. A. Wolf | 50 | 82 | .99 | 1.30 | 81 |

*Daily gage height, in feet, of West Fork of Walker River near Coleville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 1.4 | 1.5 | 1.7 | 2.9 | 3.1 | 2.9 | 1.9 | 1.2 | 1.2 | 1.1 | 0.9 |
| 2 | 1.3 | 1.4 | 1.5 | 1.7 | 2.7 | 3.1 | 2.9 | 1.9 | 1.1 | 1.2 | 1.1 | .9 |
| 3 | 1.2 | 1.4 | 1.5 | 1.8 | 2.7 | 3.0 | 2.8 | 1.8 | 1.2 | 1.2 | 1.1 | 1.1 |
| 4 | 1.2 | 1.4 | 1.6 | 1.8 | 2.6 | 3.1 | 2.7 | 1.8 | 1.2 | 1.2 | 1.9 | 1.1 |
| 5 | 1.2 | 1.3 | 1.7 | 2.0 | 2.1 | 3.1 | 2.6 | 1.8 | 1.2 | 1.2 | 1.1 | 1.1 |
| 6 | 1.2 | 1.3 | 1.7 | 2.1 | 2.3 | 3.0 | 2.7 | 1.7 | 1.2 | 1.05 | 1.1 | 1.1 |
| 7 | 1.2 | 1.4 | 1.7 | 2.1 | 2.3 | 2.9 | 2.7 | 1.6 | 1.2 | 1.1 | 1.1 | 1.1 |
| 8 | 1.2 | 1.4 | 1.7 | 2.1 | 2.2 | 3.0 | 2.8 | 1.6 | 1.2 | 1.1 | 1.1 | 1.1 |
| 9 | 1.2 | 1.4 | 1.7 | 2.2 | 2.2 | 3.1 | 2.8 | 1.6 | 1.2 | 1.05 | 1.1 | 1.2 |
| 10 | 1.2 | 1.3 | 1.7 | 2.1 | 2.1 | 3.2 | 2.7 | 1.6 | 1.1 | 1.05 | 1.1 | 1.2 |
| 11 | 1.2 | 1.3 | 1.7 | 2.1 | 2.1 | 3.5 | 2.7 | 1.5 | 1.1 | 1.05 | 1.1 | 1.1 |
| 12 | 1.2 | 1.3 | 1.7 | 2.1 | 2.2 | 3.7 | 2.6 | 1.5 | 1.1 | 1.05 | .9 | 1.1 |
| 13 | 1.2 | 1.3 | 1.7 | 2.1 | 2.3 | 3.9 | 2.5 | 1.5 | 1.1 | 1.05 | .9 | 1.1 |
| 14 | 1.2 | 1.3 | 1.7 | 2.1 | 2.9 | 3.9 | 2.5 | 1.5 | 1.1 | 1.05 | .8 | 1.1 |
| 15 | 1.2 | 1.3 | 1.7 | 2.0 | 3.4 | 3.8 | 2.4 | 1.5 | 1.1 | 1.05 | .8 | 1.2 |
| 16 | 1.2 | 1.4 | 1.7 | 2.1 | 3.5 | 3.6 | 2.4 | 1.5 | 1.1 | 1.0 | .8 | 1.2 |
| 17 | 1.2 | 1.4 | 1.7 | 2.1 | 3.5 | 3.6 | 2.3 | 1.4 | 1.1 | 1.0 | .9 | 1.1 |
| 18 | 1.2 | 1.3 | 1.8 | 2.2 | 3.6 | 3.7 | 2.2 | 1.4 | 1.1 | 1.0 | .9 | 1.1 |
| 19 | 1.2 | 1.3 | 1.8 | 2.2 | 3.5 | 3.8 | 2.1 | 1.4 | 1.1 | 1.0 | .9 | 1.1 |
| 20 | 1.3 | 1.3 | 1.8 | 2.1 | 3.5 | 3.9 | 2.1 | 1.4 | 1.05 | 1.0 | .9 | 1.1 |
| 21 | 1.3 | 1.3 | 1.7 | 2.0 | 3.4 | 3.8 | 2.2 | 1.4 | 1.05 | 1.0 | .9 | 1.1 |
| 22 | 1.3 | 1.3 | 1.7 | 2.1 | 3.3 | 3.7 | 2.2 | 1.4 | 1.05 | 1.0 | .8 | 1.1 |
| 23 | 1.3 | 1.3 | 1.6 | 2.2 | 3.2 | 3.5 | 2.2 | 1.4 | 1.05 | 1.0 | .9 | 1.1 |
| 24 | 1.4 | 1.3 | 1.6 | 2.2 | 3.3 | 3.3 | 2.2 | 1.4 | 1.05 | 1.0 | .9 | 1.2 |
| 25 | 1.4 | 1.4 | 1.6 | 2.4 | 3.3 | 3.1 | 2.2 | 1.3 | 1.05 | 1.0 | .8 | 1.2 |
| 26 | 1.3 | 1.4 | 1.6 | 2.5 | 3.2 | 3.0 | 2.1 | 1.3 | 1.05 | 1.0 | .9 | 1.2 |
| 27 | 1.3 | 1.4 | 1.6 | 2.4 | 3.0 | 2.9 | 2.1 | 1.2 | 1.05 | 1.0 | .9 | 1.1 |
| 28 | 1.3 | 1.5 | 1.6 | 2.9 | 2.9 | 2.8 | 2.1 | 1.2 | 1.2 | 1.0 | .9 | 1.1 |
| 29 | 1.3 | ....... | 1.6 | 3.1 | 2.8 | 2.8 | 2.0 | 1.2 | 1.2 | 1.0 | 1.1 | .9 |
| 30 | 1.3 | ....... | 1.8 | 3.1 | 3.0 | 2.9 | 2.0 | 1.2 | 1.2 | 1.0 | 1.1 | .9 |
| 31 | 1.3 | ....... | 1.7 | ....... | 3.1 | ....... | 2.0 | 1.2 | ....... | 1.0 | ....... | .9 |

*Station rating table for West Fork of Walker River near Coleville, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 44 | 1.60 | 121 | 2.40 | 317 | 3.20 | 702 |
| .90 | 50 | 1.70 | 138 | 2.50 | 353 | 3.30 | 762 |
| 1.00 | 56 | 1.80 | 157 | 2.60 | 393 | 3.40 | 823 |
| 1.10 | 62 | 1.90 | 178 | 2.70 | 436 | 3.50 | 886 |
| 1.20 | 70 | 2.00 | 201 | 2.80 | 483 | 3.60 | 952 |
| 1.30 | 80 | 2.10 | 226 | 2.90 | 534 | 3.70 | 1,020 |
| 1.40 | 92 | 2.20 | 254 | 3.00 | 588 | 3.80 | 1,090 |
| 1.50 | 106 | 2.30 | 284 | 3.10 | 644 | 3.90 | 1,160 |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905. It is well defined between gage heights 1.2 feet and 3.5 feet.

*Estimated monthly discharge of West Fork of Walker River near Coleville, Cal., for 1905.*

[Drainage area, 306 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 92 | 70 | 75.3 | 4,630 | 0.246 | 0.284 |
| February | 106 | 80 | 86.1 | 4,782 | .281 | .293 |
| March | 157 | 106 | 133 | 8,178 | .435 | .502 |
| April | 644 | 138 | 266 | 15,830 | .869 | .970 |
| May | 952 | 226 | 558 | 34,310 | 1.82 | 2.10 |
| June | 1,160 | 483 | 791 | 47,070 | 2.58 | 2.88 |
| July | 534 | 201 | 334 | 20,540 | 1.09 | 1.26 |
| August | 178 | 70 | 107 | 6,579 | .350 | .404 |
| September | 70 | 59 | 64.1 | 3,814 | .209 | .233 |
| October | 70 | 56 | 59.4 | 3,652 | .194 | .224 |
| November | 178 | 44 | 58.1 | 3,457 | .190 | .212 |
| December | 70 | 50 | 61.9 | 3,806 | .202 | .233 |
| The year | 1,160 | 44 | 216 | 156,600 | .706 | 9.60 |

NOTE.—Ice conditions not known. Open-channel rating table applied to winter months without correction.

## EAST FORK OF WALKER RIVER NEAR YERINGTON, NEV.

This station was established October 6, 1902. It is located at Ross Ranch, about 10 miles southeast of Yerington, Nev., just above the point where the road crosses the river.

The channel is straight for 200 feet above and for 100 feet below the station. At low water the sand bar in the middle of the stream divides the channel into two parts. Both banks are low and are liable to overflow. The bed of the stream is composed of sand and clay and shifts somewhat. The current has a moderate velocity.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by I. A. Strosnider, the ranch owner, is a vertical 4 by 4 inch timber fastened to the right bank just below the cable. The bench mark consists of three nails and a spike in a stump 6 inches in diameter 15 feet east of the gage; elevation above zero of gage, 5.85 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 85, p 107; 100, p 170; 133, p 325.
**Discharge:** 85, p 108; 100, p 170; 133, p 326.

Discharge, monthly: 100, p 172; 133, p 327.
Gage heights: 85, p 108; 100, pp 170-171; 133, p 326.
Rating table: 100, p 171; 133, p 327.

*Discharge measurements of East Fork of Walker River near Yerington, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 4 | J. L. Brambila | 50 | 36 | 1.86 | 1.80 | 67 |
| May 9 | do | 73 | 36 | 1.92 | 1.79 | 69 |
| May 18 | do | 73 | 54 | 2.10 | 2.50 | 113 |
| May 23 | do | 54 | 37 | 2.20 | 1.92 | 81 |
| June 5 | do | 49 | 28 | 2.14 | 1.90 | 60 |
| June 15 | do | 72 | 70 | 2.43 | 2.40 | 170 |
| June 19 | do | 73 | 99 | 2.94 | 2.75 | 291 |
| June 30 | do | 71 | 69 | 2.27 | 2.35 | 156 |
| July 7 | do | 72 | 64 | 2.19 | 2.30 | 141 |
| July 26 | do | 71 | 48 | 1.73 | 2.08 | 82 |
| July 28 | do | 72 | 51 | 1.66 | 2.05 | 84 |

*Daily gage height, in feet, of East Fork of Walker River near Yerington, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.1 | 2.2 | 2.4 | 2.2 | 1.5 | 2.1 | 2.3 | 1.9 | 1.6 | 1.7 | 1.9 | 2.0 |
| 2 | 2.1 | 2.2 | 2.4 | 2.2 | 1.5 | 2.1 | 2.35 | 1.9 | 1.6 | 1.7 | 1.9 | 2.0 |
| 3 | 2.1 | 2.2 | 2.4 | 2.2 | 1.5 | 2.05 | 2.4 | 1.9 | 1.6 | 1.7 | 1.9 | 2.0 |
| 4 | 2.1 | 2.2 | 2.4 | 2.2 | 1.5 | 2.05 | 2.4 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 5 | 2.1 | 2.3 | 2.35 | 2.2 | 1.45 | 2.0 | 2.4 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 6 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 1.9 | 2.3 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 7 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 1.9 | 2.3 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 8 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 1.9 | 2.25 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 9 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 1.9 | 2.2 | 1.8 | 1.7 | 1.7 | 1.9 | 1.9 |
| 10 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 1.9 | 2.2 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 11 | 2.1 | 2.3 | 2.3 | 2.2 | 1.4 | 2.0 | 2.2 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 12 | 2.1 | 2.3 | 2.3 | 2.1 | 1.4 | 2.1 | 2.3 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 13 | 2.15 | 2.3 | 2.3 | 2.1 | 1.45 | 2.2 | 2.3 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 14 | 2.2 | 2.3 | 2.3 | 2.1 | 1.45 | 2.3 | 2.2 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 15 | 2.2 | 2.3 | 2.3 | 2.1 | 1.65 | 2.4 | 2.1 | 1.7 | 1.6 | 1.6 | 1.9 | 1.9 |
| 16 | 2.2 | 2.3 | 2.2 | 2.1 | 1.75 | 2.5 | 2.0 | 1.7 | 1.6 | 1.7 | 1.9 | 1.9 |
| 17 | 2.2 | 2.3 | 2.2 | 2.1 | 2.0 | 2.65 | 2.0 | 1.6 | 1.7 | 1.7 | 1.9 | 1.9 |
| 18 | 2.2 | 2.3 | 2.2 | 2.0 | 2.2 | 2.7 | 2.0 | 1.6 | 1.7 | 1.7 | 1.9 | 1.9 |
| 19 | 2.2 | 2.4 | 2.2 | 2.0 | 2.2 | 2.7 | 2.0 | 1.6 | 1.7 | 1.7 | 1.9 | 1.9 |
| 20 | 2.2 | 2.4 | 2.2 | 2.0 | 2.2 | 2.75 | 1.95 | 1.6 | 1.7 | 1.7 | 2.0 | 1.9 |
| 21 | 2.2 | 2.4 | 2.2 | 1.9 | 2.1 | 2.75 | 1.9 | 1.6 | 1.7 | 1.7 | 2.0 | 1.9 |
| 22 | 2.2 | 2.4 | 2.2 | 1.9 | 2.1 | 2.75 | 1.95 | 1.75 | 1.7 | 1.7 | 2.0 | 1.9 |
| 23 | 2.2 | 2.4 | 2.2 | 1.9 | 2.1 | 2.85 | 2.1 | 1.8 | 1.7 | 1.8 | 2.0 | 1.9 |
| 24 | 2.2 | 2.4 | 2.2 | 1.8 | 2.0 | 2.85 | 2.1 | 1.8 | 1.7 | 1.8 | 2.0 | 1.9 |
| 25 | 2.2 | 2.4 | 2.2 | 1.8 | 2.0 | 2.75 | 2.1 | 1.8 | 1.7 | 1.8 | 2.0 | 1.9 |
| 26 | 2.2 | 2.4 | 2.2 | 1.7 | 2.0 | 2.55 | 2.1 | 1.7 | 1.7 | 1.8 | 2.0 | 1.9 |
| 27 | 2.2 | 2.4 | 2.2 | 1.7 | 2.0 | 2.4 | 2.1 | 1.7 | 1.7 | 1.9 | 2.0 | 1.9 |
| 28 | 2.2 | 2.4 | 2.2 | 1.75 | 2.2 | 2.3 | 2.05 | 1.7 | 1.7 | 1.9 | 2.0 | 1.9 |
| 29 | 2.2 | ....... | 2.2 | 1.6 | 2.2 | 2.35 | 2.0 | 1.7 | 1.8 | 1.9 | 2.0 | 1.9 |
| 30 | 2.2 | ....... | 2.2 | 1.6 | 2.1 | 2.4 | 2.0 | 1.6 | 1.8 | 1.9 | 2.0 | 1.9 |
| 31 | 2.2 | ....... | 2.2 | ....... | 2.1 | ....... | 1.9 | 1.6 | ....... | 1.9 | ....... | 1.9 |

*Daily discharge, in second-feet, of East Fork of Walker River near Yerington, Nev., for 1905.*

| Day. | May. | June. | July. | Day. | May. | June. | July. | Day. | May. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 37 | 91 | 146 | 12 | 15 | 109 | 134 | 22 | 94 | 280 | 69 |
| 2 | 37 | 91 | 156 | 13 | 18 | 125 | 134 | 23 | 110 | 304 | 90 |
| 3 | 37 | 84 | 166 | 14 | 18 | 150 | 116 | 24 | 95 | 304 | 90 |
| 4 | 37 | 79 | 162 | 15 | 25 | 170 | 100 | 25 | 95 | 275 | 83 |
| 5 | 32 | 72 | 162 | 16 | 34 | 191 | 80 | 26 | 87 | 210 | 83 |
| 6 | 27 | 60 | 143 | 17 | 46 | 237 | 80 | 27 | 87 | 176 | 83 |
| 7 | 27 | 60 | 143 | 18 | 69 | 262 | 80 | 28 | 118 | 156 | 84 |
| 8 | 25 | 66 | 130 | 19 | 69 | 291 | 80 | 29 | 115 | 156 | 78 |
| 9 | 25 | 66 | 123 | 20 | 81 | 306 | 73 | 30 | 98 | 156 | 78 |
| 10 | 25 | 72 | 123 | 21 | 82 | 306 | 63 | 31 | 98 | ...... | 65 |
| 11 | 25 | 86 | 115 | | | | | | | | |

NOTE.—Discharge applied by indirect method for shifting channels. As no measurements were made January-April and August-December no estimates for these months can be made.

*Estimated monthly discharge of East Fork of Walker River near Yerington, Nev., for 1905.*

[Drainage area, 1,103 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May | 118 | 15 | 57.7 | 3,548 | 0.052 | 0.060 |
| June | 306 | 60 | 167 | 9,937 | .151 | .168 |
| July | 166 | 63 | 107 | 6,579 | .097 | .112 |

## WALKER RIVER NEAR WABUSKA, NEV.

This station was established July 22, 1902, and equipped December 12, 1902. It is located about 300 feet above the Carson and Colorado Railroad bridge, near the section house at Clever station, and about 2½ miles east of Wabuska.

The channel is straight for 150 feet above the station and slightly curved for the same distance below. Both banks are high and are not liable to overflow. The bed of the stream is sandy and shifting. There is but one channel at all stages. The current has a moderate velocity, and the discharge is small from August to October.

Discharge measurements are made by means of a cable and car 35 feet below the gage. The initial point for soundings is the zero of the tagged wire.

The gage is read twice each day by Charles Nelson. The original gage was washed out December 30, 1903. A new gage, consisting of a 1 by 4 inch board fastened to a vertical 4 by 4 inch timber, was installed January 17, 1904. It is on the left bank, 15 feet below the point at which the old gage was located and 150 feet south of the section house. The datum is the same as that of the original gage. The bench mark consists of four nails driven into the northwest corner of the pump platform 35 feet east of the gage; elevation above zero of gage, 6.94 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 106; 100, p 167; 133, p 328.
Discharge: 85, p 107; 100, p 168; 133, p 328.
Discharge, monthly: 100, p 169; 133, p 330.
Gage heights: 85, p 107; 100, p 168; 133, p 329.
Rating table: 100, p 169; 133, p 329–330.

*Discharge measurements of Walker River near Wabuska, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 5 | J. L. Brambila | 74 | 64 | 1.46 | 1.58 | 94 |
| May 8 | do | 73 | 50 | 1.42 | 1.39 | 71 |
| May 19 | do | 78 | 136 | 2.43 | 2.30 | 330 |
| May 22 | do | 72 | 118 | 2.55 | 2.30 | 304 |
| June 4 | do | 70 | 69 | 1.79 | 1.60 | 124 |
| June 18 | do | 74 | 186 | 2.08 | 2.80 | 536 |
| July 1 | do | 70 | 64 | 1.78 | 1.40 | 114 |
| July 6 | do | 67 | 37 | 1.54 | 1.10 | 57 |
| July 27 | do | 15 | | | .60 | [a] 34 |

[a] Estimated.

*Daily gage height, in feet, of Walker River, near Wabuska, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.1 | 1.92 | 1.98 | 1.95 | 1.28 | 1.72 | 1.4 | 0.6 | 0.45 | 0.5 | 0.45 | 0.75 |
| 2 | 2.05 | 2.0 | 2.0 | 2.0 | 1.58 | 1.7 | 1.4 | .55 | .45 | .5 | .45 | .75 |
| 3 | 2.05 | 2.05 | 2.0 | 2.0 | 1.75 | 1.7 | 1.33 | .55 | .45 | .5 | .45 | .7 |
| 4 | 2.0 | 2.1 | 2.0 | 1.98 | 1.7 | 1.62 | 1.28 | .55 | .45 | .5 | .45 | .75 |
| 5 | 2.0 | 2.1 | 2.0 | 1.94 | 1.63 | 1.6 | 1.2 | .55 | .45 | .5 | .45 | .8 |
| 6 | 2.0 | 2.05 | 2.02 | 1.92 | 1.58 | 1.65 | 1.2 | .55 | .45 | .5 | .45 | .95 |
| 7 | 2.0 | 2.05 | 2.05 | 1.82 | 1.48 | 1.72 | 1.13 | .55 | .45 | .5 | .45 | .95 |
| 8 | 2.0 | 2.02 | 2.05 | 1.8 | 1.4 | 1.82 | 1.1 | .5 | .45 | .5 | .45 | 1.0 |
| 9 | 2.0 | 2.0 | 2.05 | 1.8 | 1.4 | 1.92 | 1.1 | .5 | .45 | .5 | .45 | 1.0 |
| 10 | 2.0 | 1.95 | 2.05 | 1.8 | 1.35 | 1.95 | 1.1 | .5 | .45 | .5 | .45 | 1.0 |
| 11 | 2.0 | 1.92 | 2.05 | 1.8 | 1.35 | 1.98 | 1.08 | .5 | .45 | .45 | .45 | 1.0 |
| 12 | 2.0 | 1.9 | 2.05 | 1.8 | 1.28 | 2.13 | 1.02 | .5 | .45 | .45 | .45 | 1.0 |
| 13 | 2.0 | 1.87 | 2.08 | 1.7 | 1.25 | 2.33 | 1.0 | .5 | .45 | .45 | .45 | 1.0 |
| 14 | 1.95 | 1.85 | 2.1 | 1.6 | 1.25 | 2.65 | 1.0 | .5 | .45 | .45 | .45 | .95 |
| 15 | 1.95 | 1.82 | 2.1 | 1.52 | 1.3 | 2.88 | .95 | .5 | .45 | .45 | .45 | .95 |
| 16 | 1.9 | 1.78 | 2.1 | 1.48 | 1.3 | 2.83 | .9 | .5 | .45 | .45 | .45 | .95 |
| 17 | 1.85 | 1.75 | 2.1 | 1.42 | 1.3 | 2.78 | .85 | .5 | .45 | .45 | .45 | .95 |
| 18 | 1.85 | 1.72 | 2.15 | 1.4 | 1.58 | 2.78 | .85 | .5 | .45 | .45 | .45 | .95 |
| 19 | 1.8 | 1.8 | 2.15 | 1.38 | 2.38 | 2.78 | .8 | .5 | .45 | .45 | .45 | .95 |
| 20 | 1.8 | 1.85 | 2.15 | 1.35 | 2.4 | 2.7 | .8 | .45 | .45 | .45 | .45 | .95 |
| 21 | 1.85 | 1.85 | 2.15 | 1.35 | 2.3 | 2.63 | .8 | .45 | .45 | .45 | .5 | .95 |
| 22 | 1.9 | 1.88 | 2.15 | 1.32 | 2.3 | 2.6 | .8 | .45 | .45 | .45 | .55 | .95 |
| 23 | 1.9 | 1.9 | 2.15 | 1.3 | 2.15 | 2.6 | .75 | .48 | .45 | .45 | .7 | .95 |
| 24 | 1.9 | 1.9 | 2.1 | 1.28 | 1.9 | 2.55 | .68 | .5 | .45 | .45 | .65 | .95 |
| 25 | 1.9 | 1.9 | 2.1 | 1.22 | 1.85 | 2.43 | .68 | .5 | .45 | .45 | .65 | .95 |
| 26 | 1.9 | 1.9 | 2.08 | 1.2 | 1.9 | 2.15 | .6 | .5 | .45 | .45 | .7 | .95 |
| 27 | 1.9 | 1.9 | 2.02 | 1.2 | 2.05 | 1.7 | .6 | .5 | .45 | .45 | .7 | 1.0 |
| 28 | 1.9 | 1.95 | 2.0 | 1.2 | 2.05 | 1.45 | .6 | .5 | .45 | .45 | .7 | 1.0 |
| 29 | 1.9 | | 2.0 | 1.15 | 2.0 | 1.38 | .6 | .45 | .45 | .45 | .7 | 1.0 |
| 30 | 1.9 | | 2.0 | 1.15 | 1.9 | 1.33 | .6 | .45 | .5 | .45 | .75 | 1.0 |
| 31 | 1.9 | | 2.0 | | 1.82 | | .6 | .45 | | .45 | | 1.0 |

**Note.**—Ice conditions not known.

*Station rating table for Walker River near Wabuska, Nev., from May 1 to June 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 40 | 1.70 | 135 | 2.20 | 280 | 2.60 | 440 |
| 1.30 | 56 | 1.80 | 159 | 2.30 | 316 | 2.70 | 488 |
| 1.40 | 73 | 1.90 | 185 | 2.40 | 354 | 2.80 | 538 |
| 1.50 | 92 | 2.00 | 214 | 2.50 | 395 | 2.90 | 588 |
| 1.60 | 113 | 2.10 | 246 | | | | |

The above table is based on six discharge measurements made during 1905. Estimates only approximate owing to shifting character of stream bed.

*Station rating table for Walker River near Wabuska, Nev., from June 16 to July 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 30 | 1.20 | 84 | 1.80 | 186 | 2.40 | 366 |
| 0.70 | 36 | 1.30 | 97 | 1.90 | 210 | 2.50 | 405 |
| 0.80 | 44 | 1.40 | 111 | 2.00 | 236 | 2.60 | 447 |
| 0.90 | 53 | 1.50 | 127 | 2.10 | 264 | 2.70 | 491 |
| 1.00 | 62 | 1.60 | 144 | 2.20 | 295 | 2.80 | 538 |
| 1.10 | 72 | 1.70 | 164 | 2.30 | 329 | | |

The above table is based on four discharge measurements made during 1905. Estimates only approximate owing to shifting character of stream bed.

*Estimated monthly discharge of Walker River near Wabuska, Nev., for 1905.*

[Drainage area, 2,420 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| May | 354 | 48 | 149 | 9,162 | 0.062 | 0.071 |
| June | 578 | 101 | 295 | 17,550 | .122 | .136 |
| July | 111 | 30 | 58.3 | 3,585 | .024 | .028 |

## CARSON RIVER BASIN.

### DESCRIPTION OF BASIN.

Carson River has its sources on the eastern slopes of the Sierra Nevada in Alpine County, Cal. Flowing northward into Nevada, East and West forks unite near Genoa, in the upper Carson Valley. At Empire, 3 miles east of the city of Carson, the river turns to the northeast and enters a deep canyon, through which it flows for several miles, emerging into a second, smaller valley a short distance above the town of Dayton. After leaving this valley it passes through two shorter canyons and one rather large valley before entering lower Carson Valley, or Carson Sink Valley, as it is also known, and discharging its waters into Carson Sink.

## WEST FORK OF CARSON RIVER NEAR WOODFORDS, CAL.

West Fork of Carson River rises in Alpine County, Cal., flows in a general northerly direction, and unites with East Fork in Douglas County, Nev.

The gaging station was established October 18, 1900. It is located about three-fourths of a mile above the post-office at Woodfords, Cal., and 200 feet from the main road between Woodfords and Blue Lakes.

The channel is straight for 100 feet above and below the cable. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rocky and uneven and is permanent. There is but one channel at all stages. At high water the velocity of the current is too great for accurate measurement.

Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is the zero of the tagged wire.

The gage, which is read once each day by Miss Bernice Merrill, is a vertical board nailed to a cottonwood tree on the left bank.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Reports; WS=Water-Supply Paper):

**Description:** WS 51, p 400; 66, p 109; 85, pp 113-114; 100, p.180; 133, p 331.

**Discharge:** WS 66, p 109; 85, p 114; 100, p 181; 133, p 331.

**Discharge, monthly:** Ann 11, ii, p 102; 12, ii, pp 351, 360; 13, iii, p 96, 14, ii, p 118; WS 75, p 188; 85, p 115; 100, p 182; 133, p 333.

**Discharge, yearly:** Ann 13, iii, p 99; 20, iv, p 59.

**Gage heights:** WS 51, p 401; 66, p 110; 85, p 114; 100, p 181; 133, p 332.

**Rating tables:** WS 66, p 175; 85, p 115; 100, p 182; 133, p 332.

*Discharge measurements of West Fork of Carson River near Woodfords, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 1 | W. A. Wolf | 28 | 53 | 1.66 | 2.85 | 88 |
| April 20 | do | 31 | 72 | 2.59 | 3.55 | 186 |
| May 2 | J. L. Brambila | 30 | 89 | 3.69 | 3.95 | 328 |
| May 12 | do | 29 | 80 | 2.61 | 3.50 | 210 |
| May 16 | do | 35 | 113 | 3.50 | 4.40 | 398 |
| May 25 | do | 30 | 95 | 3.19 | 4.15 | 305 |
| May 30 | do | 30 | 95 | 3.11 | 4.00 | 298 |
| June 7 | do | 30 | 80 | 2.77 | 3.75 | 223 |
| June 12 | do | 30 | 95 | 3.04 | 4.10 | 288 |
| June 22 | do | 30 | 76 | 2.48 | 3.60 | 188 |
| June 28 | do | 30 | 57 | 2.09 | 3.20 | 119 |
| July 10 | do | 30 | 52 | 2.00 | 2.90 | 104 |
| July 22 | do | 29 | 46 | 1.57 | 2.50 | 72 |
| July 30 | do | 28 | 34 | 1.30 | 2.35 | 44 |
| August 29 | W. A. Wolf | 28 | 26 | .96 | 2.10 | 25 |

*Daily gage height, in feet, of West Fork of Carson River near Woodfords, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 2.97 | 3.05 | 2.93 | 4.16 | 3.85 | 3.1 | 2.3 | 2.0 | 2.2 | 2.2 | 2.3 |
| 2 | ....... | 3.01 | 3.18 | 2.93 | 4.2 | 3.8 | 3.05 | 2.35 | 2.0 | 2.15 | 2.2 | 2.3 |
| 3 | ....... | 3.01 | 3.05 | 2.97 | 3.9 | 3.75 | 3.05 | 2.2 | 2.0 | 2.1 | 2.2 | 2.3 |
| 4 | ....... | 2.97 | 3.05 | 2.89 | 3.85 | 3.55 | 2.97 | 2.3 | 2.0 | 2.1 | 2.2 | 2.3 |
| 5 | ....... | 2.93 | 3.05 | 2.89 | 3.7 | 3.5 | 2.8 | 2.25 | 2.05 | 2.1 | 2.2 | 2.4 |
| 6 | ....... | 3.01 | 2.97 | 2.97 | 3.7 | 3.55 | 2.89 | 2.25 | 2.0 | 2.15 | 2.2 | 2.4 |
| 7 | ....... | 3.05 | 3.01 | 3.05 | 3.65 | 3.7 | 2.89 | 2.25 | 2.0 | 2.15 | 2.2 | 2.5 |
| 8 | 2.77 | 3.05 | 3.05 | 3.14 | 3.6 | 3.65 | 2.75 | 2.15 | 2.0 | 2.2 | 2.2 | 2.4 |
| 9 | 2.81 | 3.05 | 3.23 | 3.23 | 3.6 | 3.6 | 2.89 | 2.15 | 2.0 | 2.2 | 2.2 | 2.5 |
| 10 | 2.81 | 3.14 | 3.23 | 3.41 | 3.65 | 3.7 | 3.14 | 2.25 | 2.0 | 2.2 | 2.2 | 2.5 |
| 11 | 2.85 | 3.05 | 3.14 | 3.41 | 3.6 | 3.75 | 3.05 | 2.2 | 2.0 | 2.2 | 2.2 | 2.5 |
| 12 | 2.89 | 3.05 | 3.05 | 3.36 | 3.65 | 3.8 | 3.05 | 2.2 | 2.0 | 2.2 | 2.2 | 2.5 |
| 13 | 2.85 | 2.97 | 3.05 | 3.36 | 3.8 | 3.75 | 2.85 | 2.15 | 2.0 | 2.2 | 2.2 | 2.6 |
| 14 | 2.85 | 3.01 | 3.14 | 3.36 | 3.9 | 3.75 | 2.75 | 2.1 | 2.0 | 2.2 | 2.2 | 2.55 |
| 15 | 2.89 | 2.89 | 3.23 | 3.81 | 4.12 | 3.75 | 2.65 | 2.1 | 2.0 | 2.15 | 2.2 | 2.6 |
| 16 | 2.81 | 2.89 | 3.18 | 3.85 | 4.08 | 3.6 | 2.65 | 2.1 | 2.0 | 2.15 | 2.2 | 2.55 |
| 17 | 2.81 | 2.85 | 3.5 | 3.75 | 4.24 | 3.65 | 2.55 | 2.0 | 2.0 | 2.1 | 2.2 | 2.6 |
| 18 | 2.85 | 2.83 | 3.41 | 3.7 | 4.4 | 3.65 | 2.6 | 2.1 | 2.05 | 2.15 | 2.2 | 2.6 |
| 19 | 2.85 | 2.81 | 3.28 | 3.6 | 4.36 | 3.6 | 2.55 | 2.1 | 2.05 | 2.15 | 2.2 | 2.6 |
| 20 | 2.85 | 2.81 | 3.23 | 3.5 | 4.36 | 3.5 | 2.5 | 2.1 | 2.1 | 2.15 | 2.2 | 2.55 |
| 21 | 2.81 | 2.85 | 3.14 | 3.85 | 4.36 | 3.5 | 2.5 | 2.1 | 2.1 | 2.2 | 2.2 | 2.55 |
| 22 | 2.89 | 2.89 | 3.14 | 3.85 | 4.36 | 3.41 | 2.45 | 2.15 | 2.1 | 2.2 | 2.2 | 2.55 |
| 23 | 2.93 | 2.89 | 3.23 | 3.95 | 4.12 | 3.36 | 2.45 | 2.1 | 2.1 | 2.2 | 2.2 | 2.65 |
| 24 | 3.05 | 2.85 | 3.14 | 4.12 | 4.16 | 3.32 | 2.5 | 2.1 | 2.1 | 2.2 | 2.2 | 2.65 |
| 25 | 2.97 | 2.89 | 3.14 | 4.16 | 4.16 | 3.32 | 2.45 | 2.1 | 2.1 | 2.2 | 2.2 | 2.55 |
| 26 | 2.93 | 2.97 | 3.23 | 4.16 | 4.16 | 3.28 | 2.4 | 2.05 | 2.2 | 2.2 | 2.2 | 2.55 |
| 27 | 2.85 | 2.97 | 3.28 | 4.24 | 4.0 | 3.23 | 2.45 | 2.0 | 2.2 | 2.2 | 2.2 | 2.55 |
| 28 | 2.81 | 3.05 | 3.14 | 4.32 | 3.9 | 3.23 | 2.4 | 2.0 | 2.2 | 2.2 | 2.4 | 2.5 |
| 29 | 2.81 | ....... | 3.05 | 4.32 | 3.8 | 3.14 | 2.5 | 2.0 | 2.2 | 2.2 | 2.45 | 2.5 |
| 30 | 2.85 | ....... | 2.89 | 4.28 | 3.85 | 3.18 | 2.35 | 2.0 | 2.2 | 2.2 | 2.3 | 2.5 |
| 31 | 2.89 | ....... | 2.89 | ....... | 3.9 | ....... | 2.3 | 2.0 | ....... | 2.2 | ....... | 2.5 |

*Station rating table for West Fork of Carson River near Woodfords, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 20 | 2.70 | 74 | 3.30 | 146 | 3.90 | 251 |
| 2.10 | 26 | 2.80 | 84 | 3.40 | 161 | 4.00 | 272 |
| 2.20 | 33 | 2.90 | 95 | 3.50 | 177 | 4.10 | 294 |
| 2.30 | 40 | 3.00 | 107 | 3.60 | 194 | 4.20 | 318 |
| 2.40 | 48 | 3.10 | 119 | 3.70 | 212 | 4.30 | 343 |
| 2.50 | 56 | 3.20 | 132 | 3.80 | 231 | 4.40 | 370 |
| 2.60 | 65 | | | | | | |

NOTE.—The above table is applicable only for open channel conditions. It is based on 15 discharge measurements made during 1905. It is fairly well defined.

*Estimated monthly discharge of West Fork of Carson River near Woodfords, Cal., for 1905.*

[Drainage area, 70 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 8-31 | 113 | 81 | 91.0 | 4,332 | 1.30 | 1.16 |
| February | 124 | 85 | 102 | 5,665 | 1.46 | 1.52 |
| March | 177 | 94 | 125 | 7,686 | 1.79 | 2.06 |
| April | 348 | 94 | 262 | 12,620 | 2.89 | 3.22 |
| May | 370 | 194 | 271 | 16,660 | 3.87 | 4.46 |
| June | 241 | 124 | 187 | 11,130 | 2.67 | 2.98 |
| July | 124 | 40 | 75.8 | 4,661 | 1.08 | 1.24 |
| August | 44 | 20 | 28.7 | 1,765 | .410 | .473 |
| September | 33 | 20 | 23.7 | 1,410 | .339 | .378 |
| October | 33 | 26 | 31.3 | 1,925 | .447 | .515 |
| November | 52 | 33 | 34.4 | 2,047 | .491 | .548 |
| December | 70 | 40 | 56.5 | 3,474 | .807 | .930 |
| The period | ........... | ........... | .......... | 72,780 | ........... | .......... |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## EAST FORK OF CARSON RIVER NEAR GARDNERVILLE, NEV.

East Fork of Carson River rises in southeastern Alpine County, flows in a general northerly direction, and joins West Fork in Douglas County, Nev.

The gaging station was established October 17, 1900. It is located about 5 miles southeast of Gardnerville, and one-half mile southwest of Rodenbah's ranch. It is within one-half mile of the main traveled road between Carson, Nev., and Bridgeport, Cal., and is about 400 feet above a bridge across the river.

The station is located at the place where measurements were made in 1890, 1891, and 1892.

The channel is straight for 300 feet above and below the station and is broad and shallow. Both banks are high and are not liable to overflow. The bed of the stream is composed of gravel and is permanent. There is but one channel at all stages and the current is moderate.

August 2, 1901, a loose-rock dam was raised a short distance below the gaging station, which affected the velocity at the latter point. This dam was washed out by a freshet December 4, 1901. On or about July 15, 1905, the dam was raised and tightened to such an extent that the water backed up to a point well above the old gage, and for this reason the readings from July 15 to October 8, 1905, are not indicative of the quantity of water flowing in the stream.

Discharge measurements are made by means of a cable and car located at the vertical gage about 400 feet above the bridge. The initial point for soundings is the zero of the tagged wire on the right bank.

The gage is read twice each day by Miss Susie Rodenbah. The original gage was an inclined timber securely fastened to posts set in the right bank of the stream. The bench mark was on a basalt rock in the edge of the stream, 20 feet from the gage and at an elevation of 6.30 feet above gage datum. A new gage was established March 10, 1901, a short distance downstream from the original gage, which had been destroyed. It consists of a vertical timber driven into the stream bed at the right bank and spiked to a cottonwood tree. October 3, 1902, a new inclined gage was installed at a point on the left bank of the river 600 feet above the cable. During 1904 and up to and including October 8, 1905, gage heights were read on the vertical gage at the cable. On the latter date a new vertical gage was installed at a point about 300 yards above the old gage and firmly fastened to the rocks. The new gage was read from October 8 to the end of the year. The bench mark for the gage at the cable is the top of a granite bowlder 20 feet south of the gage; elevation above zero of gage, 8.10 feet. The bench mark for the new gage is a cross cut in a bowlder 8 feet northeast of the gage; elevation, 6.36 feet above zero of gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

**Discription:** Ann 14, ii, p 116; WS 51, pp 399-400; 66, p 108; 85, pp 111-112; 100, pp. 177-178; 133, p 333-334.

**Discharge:** WS 66, p 108; 85, p 112; 100, p 178; 133, p 334.

**Discharge, monthly:** Ann 11, ii, p 102; 12, ii, pp 351, 360; 13, iii, p 95; 14, ii, pp. 116-117; WS 75, p. 187; 85, p 113; 100, p 180; 133, p 336.

**Discharge, yearly:** Ann 13, iii, p 99; 20, iv, p 59.

**Gage heights:** WS 51, p 400; 66, p 109; 85, p 112; 100, pp 178-179; 133, p 335.

**Hydrograph:** Ann 14, ii, p 116.

**Rating tables:** WS 66, p 175; 85, p 113; 100, p 179; 133, p 336.

*Discharge measurements of East Fork of Carson River near Gardnerville, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 2 | W. A. Wolf | 88 | 179 | 1.15 | 3.80 | 206 |
| April 21 | do | 89 | 201 | 1.93 | 4.15 | 389 |
| May 2 | J. L. Brambila | 93 | 256 | 3.00 | 4.65 | 767 |
| May 11 | do | 88 | 206 | 2.15 | 4.15 | 444 |
| May 16 | do | 94 | 277 | 3.48 | 5.00 | 968 |
| May 25 | do | 88 | 291 | 4.10 | 5.22 | 1,205 |
| May 30 | do | 88 | 258 | 3.40 | 4.85 | 877 |
| June 7 | do | 89 | 264 | 3.48 | 4.90 | 929 |
| June 13 | do | 90 | 297 | 4.00 | 5.22 | 1,186 |
| June 21 | do | 89 | 270 | 3.25 | 4.85 | 879 |
| June 28 | do | 85 | 207 | 2.33 | 4.25 | 482 |
| July 9 | do | 87 | 187 | 1.62 | 4.00 | 304 |
| July 24 | do | 86 | 168 | .96 | 3.90 | 161 |
| July 30 | do | 86 | 171 | .61 | 3.90 | 105 |
| August 7 | W. A. Wolf | 87 | 147 | .70 | 3.65 | 90 |
| August 9 | do | 87 | 176 | .62 | 3.93 | 111 |
| August 31 | do | 72 | 115 | .51 | 3.20 | 60 |
| November 2 | John Smith | 80 | 127 | .56 | 2.10 | 71 |
| November 4 | do | 80 | 120 | .57 | 2.10 | 68 |

*Daily gage height, in feet, of East Fork of Carson River near Gardnerville, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 3.58 | 5.19 | 3.85 | 4.5 | 4.71 | 4.37 | 3.79 | 3.4 | 3.33 | 3.3 | 3.1 |
| 2 | 2.32 | 3.58 | 5.19 | 4.3 | 5.1 | 4.68 | 4.25 | 3.8 | 3.39 | 3.33 | 3.25 | 3.1 |
| 3 | 2.34 | 3.58 | 5.2 | 4.25 | 5.5 | 4.3 | 4.2 | 3.8 | 3.39 | 3.32 | 3.2 | 3.1 |
| 4 | 2.25 | 3.6 | 5.2 | 4.1 | 5.2 | 4.35 | 4.2 | 3.82 | 3.38 | 3.33 | 3.2 | 3.05 |
| 5 | 2.24 | 3.58 | 4.88 | 4.15 | 4.95 | 4.45 | 4.19 | 3.78 | 3.37 | 3.4 | 3.3 | 3.04 |
| 6 | 2.24 | 3.54 | 4.8 | 4.2 | 4.6 | 4.56 | 4.15 | 3.78 | 3.37 | 3.4 | 3.25 | 3.04 |
| 7 | 2.24 | 3.54 | 4.78 | 4.12 | 4.15 | 4.66 | 4.12 | 3.72 | 3.37 | 3.4 | 3.2 | 3.04 |
| 8 | 2.65 | 3.55 | 4.68 | 4.12 | 4.0 | 4.69 | 4.12 | 3.66 | 3.36 | 3.3 | 3.2 | 3.04 |
| 9 | 2.8 | 3.56 | 4.62 | 4.1 | 3.9 | 4.75 | 4.11 | 3.66 | 3.36 | 3.3 | 3.2 | 3.03 |
| 10 | 2.88 | 3.58 | 4.6 | 3.9 | 3.8 | 4.75 | 4.1 | 3.95 | 3.33 | 3.3 | 3.2 | 3.04 |
| 11 | 2.98 | 3.58 | 4.6 | 3.85 | 4.08 | 4.8 | 4.05 | 4.23 | 3.32 | 3.32 | 3.2 | 3.05 |
| 12 | 3.2 | 4.0 | 4.45 | 3.85 | 3.95 | 4.9 | 4.0 | ....... | 3.22 | 3.3 | 3.2 | 3.05 |
| 13 | 3.38 | 4.0 | 4.5 | 3.9 | 4.11 | 4.95 | 3.88 | 4.18 | 3.21 | 3.3 | 3.15 | 3.05 |
| 14 | 3.6 | 4.12 | 4.28 | 3.9 | 4.65 | 4.88 | 3.83 | 3.65 | 3.2 | 3.3 | 3.15 | 3.05 |
| 15 | 3.65 | 4.12 | 4.21 | 3.92 | 5.4 | 4.88 | 3.78 | 3.78 | 3.19 | 3.3 | 3.15 | 3.07 |
| 16 | 3.6 | 4.13 | 4.19 | 3.91 | 6.0 | 4.85 | 3.74 | 3.78 | 3.19 | 3.32 | 3.15 | 3.09 |
| 17 | 3.6 | 4.14 | 4.18 | 3.9 | 5.75 | 4.85 | 3.9 | 3.78 | 3.19 | 3.3 | 3.15 | 3.1 |
| 18 | 3.62 | 4.14 | 4.14 | 3.89 | 5.65 | 4.9 | 3.85 | 3.78 | 3.19 | 3.3 | 3.15 | 3.1 |
| 19 | 3.6 | 4.14 | 4.05 | 3.89 | 5.4 | 4.93 | 3.74 | 3.68 | 3.19 | 3.3 | 3.1 | 3.1 |
| 20 | 3.62 | 4.59 | 4.0 | 3.9 | 5.49 | 4.92 | 3.7 | 3.64 | 3.19 | 3.3 | 3.1 | 3.12 |
| 21 | 3.63 | 5.0 | 3.9 | 3.92 | 5.42 | 4.83 | 3.71 | 3.62 | 3.18 | 3.3 | 3.1 | 3.12 |
| 22 | 3.64 | 5.1 | 3.95 | 3.95 | 5.25 | 4.8 | 3.7 | 3.59 | 3.18 | 3.3 | 3.1 | 3.12 |
| 23 | 3.66 | 5.14 | 3.95 | 3.98 | 5.15 | 4.68 | 3.72 | 3.59 | 3.17 | 3.2 | 3.1 | 3.13 |
| 24 | 3.65 | 5.16 | 3.92 | 4.0 | 5.18 | 4.6 | 3.72 | 3.52 | 3.16 | 3.2 | 3.1 | 3.13 |
| 25 | 3.64 | 5.19 | 3.95 | 4.18 | 5.13 | 4.53 | 3.76 | 3.5 | 3.15 | 3.2 | 3.1 | 3.13 |
| 26 | 3.6 | 5.12 | 3.95 | 4.2 | 4.97 | 4.53 | 3.79 | 3.5 | 3.16 | 3.2 | 3.1 | 3.14 |
| 27 | 3.6 | 5.12 | 3.85 | 4.21 | 4.85 | 4.49 | 3.84 | 3.5 | 3.2 | 3.2 | 3.1 | 3.15 |
| 28 | 3.6 | 5.12 | 3.8 | 4.22 | 4.83 | 4.41 | 3.85 | 3.47 | 3.3 | 3.3 | 3.1 | 3.15 |
| 29 | 3.6 | ....... | 3.8 | 4.28 | 4.85 | 4.39 | 3.85 | 3.41 | 3.4 | 3.3 | 3.1 | 3.16 |
| 30 | 3.6 | ....... | 3.8 | 4.3 | 4.85 | 4.38 | 3.86 | 3.4 | 3.33 | 3.3 | 3.1 | 3.16 |
| 31 | 3.6 | ....... | 3.85 | ....... | 4.83 | ....... | 3.86 | 3.4 | ....... | 3.3 | ....... | 3.15 |

NOTE.—October 8 to December 31, readings made on new gage and reduced to same datum as gage used during the first part of the year.

*Station rating table for East Fork of Carson River near Gardnerville, Nev., from January 1 to July 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 8 | 2.80 | 43 | 3.60 | 158 | 4.40 | 527 |
| 2.10 | 9 | 2.90 | 51 | 3.70 | 186 | 4.50 | 600 |
| 2.20 | 11 | 3.00 | 60 | 3.80 | 218 | 4.60 | 675 |
| 2.30 | 14 | 3.10 | 71 | 3.90 | 254 | 4.70 | 753 |
| 2.40 | 18 | 3.20 | 83 | 4.00 | 295 | 4.80 | 833 |
| 2.50 | 23 | 3.30 | 97 | 4.10 | 342 | 4.90 | 915 |
| 2.60 | 29 | 3.40 | 114 | 4.20 | 397 | 5.00 | 1,000 |
| 2.70 | 36 | 3.50 | 134 | 4.30 | 459 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during first half of 1904 and 1905, and several low-water measurements of 1903. It is well defined between gage heights 3 feet and 5 feet. Above 5 feet the curve depends on one measurement at gage height 6.15 feet.

*Estimated monthly discharge of East Fork of Carson River near Gardnerville, Nev., for 1905.*

[Drainage area, 381 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 175 | 12 | 110 | 6,763 | 0.289 | 0.333 |
| February | 1,166 | 144 | 496 | 27,550 | 1.30 | 1.35 |
| March | 1,175 | 218 | 533 | 32,770 | 1.40 | 1.61 |
| April | 459 | 236 | 322 | 19,160 | .845 | .943 |
| May | 1,930 | 218 | 949 | 58,350 | 2.49 | 2.87 |
| June | 958 | 450 | 742 | 44,150 | 1.95 | 2.18 |
| July 1-15 | 507 | 212 | 346 | 10,290 | .908 | .506 |
| The period | | | | 199,000 | | |

NOTE.—Ice conditions not known. Open-channel rating table applied to winter months without correction.

## CARSON RIVER NEAR EMPIRE, NEV.

This station was established October 21, 1900. It is located about three-fourths of a mile east of Brunswick Mill and 2½ miles east of Empire, Nev.

The channel is straight for 100 feet above and below the station. Both banks are high, rocky, and will not overflow. The bed of the stream is composed of solid rock, gravel, and cobblestones, and is not likely to shift. At flood stages the stream is too deep and swift for satisfactory measurement; at low water the current is sluggish.

Discharge measurements are made by means of a cable and car just below the gage. The initial point for soundings is the zero of the tagged wire on the left bank. Low-water measurements are made by wading one-fourth mile below the cable.

The gage is read once each day by David Lloyd. The original gage was located upstream from the site of the present station. February 18, 1901, the erosion of a bar in the channel above the gage caused the division of the stream into two channels, and on this account the present gage was installed March 13, 1901. The gage consists of an inclined 4 by 4 inch timber spiked to a cottonwood tree on the left bank. November 11, 1903, the gage datum was lowered 1.3 feet to enable readings to be made at extreme low water. The gage is referred to bench marks as follows: (1) Top of a bowlder on the left bank 2 feet west of the gage. Its elevation is 7.10 feet above the zero of the gage as originally established and 8.40 feet above the gage in its present position. (2) Top of bowlder on the left bank 10 feet north of the gage. Elevation is 8.38 feet above the zero of the gage as originally established and 9.68 feet above the zero of the gage in its present position.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull.=Bulletin; WS=Water-Supply Paper):

Description: Ann 12, ii, p 325; Bull 140, p 212; WS 51, p 401; 66, p 110; 85, p 109; 100, p 175; 133, p 337.
Discharge: Bull 140, p 213; WS 66, p 111; 85, p 109; 100, p 175; 133, p 337.
Discharge, monthly. WS 75, p 189; 85, p 111; 100, p 177; 133, p 339.
Gage heights: Bull 140, p 213, WS 51, p 401; 66, p 111; 85, p 110; 100, p 176; 133, p 338.
Hydrographs: Ann 12, ii, p 324; WS 75, p 189.
Rating tables: WS 66, p 175; 85, p 110; 100, p 176; 133, p 338.

*Discharge measurements of Carson River near Empire, Nev., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 3 | W. A. Wolf | 79 | 187 | 1.92 | 3.25 | 359 |
| May 7 | J. L. Brambila | 85 | 266 | 2.75 | 4.05 | 731 |
| May 13 | do | 85 | 233 | 2.08 | 3.50 | 486 |
| May 20 | do | 86 | 327 | 3.88 | 4.80 | 1,270 |
| May 27 | do | 85 | 321 | 3.54 | 4.60 | 1,138 |
| June 3 | do | 85 | 275 | 3.01 | 4.15 | 830 |
| June 9 | do | 83 | 256 | 2.51 | 3.90 | 642 |
| June 17 | do | 86 | 288 | 3.11 | 4.30 | 901 |
| June 24 | do | 80 | 231 | 2.33 | 3.70 | 539 |
| July 2 | do | 80 | 182 | 1.85 | 3.18 | 338 |
| July 11 | do | 67 | 124 | .90 | 2.22 | 111 |
| July 21 | do | 57 | 95 | .55 | 1.95 | 53 |

*Daily gage height, in feet, of Carson River near Empire, Nev., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.35 | 2.9 | 3.1 | 3.3 | 4.9 | 4.4 | 3.1 | 1.4 | 1.1 | 1.4 | 2.1 | 2.2 |
| 2 | 3.3 | 3.2 | 3.1 | 3.3 | 4.5 | 4.4 | 3.2 | 1.4 | .8 | 1.5 | 2.1 | 2.2 |
| 3 | 2.9 | 3.2 | 3.1 | 3.4 | 4.4 | 4.3 | 3.0 | 1.3 | 1.1 | 1.6 | 2.0 | 2.3 |
| 4 | 2.9 | 3.2 | 3.1 | 3.4 | 4.4 | 4.1 | 2.9 | 1.2 | .7 | 1.6 | 2.0 | 2.3 |
| 5 | 3.0 | 3.2 | 3.2 | 3.4 | 4.3 | 4.0 | 2.7 | 1.3 | .7 | 1.6 | 2.0 | 2.4 |
| 6 | 3.0 | 3.2 | 3.2 | 3.5 | 4.2 | 3.9 | 2.5 | 1.2 | 1.2 | 1.7 | 2.0 | 2.4 |
| 7 | 3.0 | 3.2 | 3.2 | 3.6 | 4.1 | 3.9 | 2.4 | 1.2 | .8 | 1.8 | 2.0 | 2.4 |
| 8 | 2.9 | 3.2 | 3.2 | 3.6 | 4.0 | 3.9 | 2.5 | 1.2 | .9 | 1.7 | 2.0 | 2.4 |
| 9 | 2.9 | 3.0 | 3.2 | 3.7 | 3.9 | 4.0 | 2.4 | 1.2 | 1.3 | 1.7 | 2.0 | 2.4 |
| 10 | 2.9 | 3.0 | 3.2 | 3.7 | 3.8 | 4.0 | 2.2 | 1.3 | 1.3 | 1.7 | 2.0 | 2.4 |
| 11 | 2.9 | 3.0 | 3.2 | 3.9 | 3.8 | 4.1 | 2.2 | 1.2 | 1.2 | 1.8 | 2.1 | 2.4 |
| 12 | 2.8 | 2.9 | 3.2 | 3.8 | 3.5 | 4.3 | 2.2 | 1.0 | .8 | 1.8 | 2.1 | 2.4 |
| 13 | 2.8 | 3.1 | 3.2 | 3.6 | 3.5 | 4.5 | 2.1 | 1.0 | 1.2 | 1.8 | 2.1 | 2.4 |
| 14 | 2.8 | 3.1 | 3.3 | 3.5 | 3.5 | 4.6 | 2.1 | 1.1 | .7 | 1.8 | 2.1 | 2.4 |
| 15 | 3.0 | 2.9 | 3.4 | 3.4 | 3.7 | 4.4 | 2.0 | 1.2 | 1.3 | 1.8 | 2.1 | 2.3 |
| 16 | 3.0 | 2.9 | 3.4 | 3.6 | 3.9 | 4.4 | 2.0 | 1.3 | .9 | 1.9 | 2.1 | 2.4 |
| 17 | 3.0 | 3.0 | 3.3 | 3.6 | 4.5 | 4.3 | 2.0 | 1.2 | 1.3 | 1.9 | 2.1 | 2.5 |
| 18 | 2.9 | 3.0 | 3.3 | 3.5 | 4.9 | 4.3 | 1.9 | 1.3 | 1.3 | 1.9 | 2.1 | 2.4 |
| 19 | 2.9 | 3.0 | 3.3 | 3.5 | 5.0 | 4.2 | 1.9 | 1.3 | .9 | 1.9 | 2.1 | 2.3 |
| 20 | 2.9 | 3.0 | 3.3 | 3.5 | 4.8 | 4.1 | 1.9 | 1.3 | 1.3 | 2.0 | 2.1 | 2.4 |
| 21 | 2.9 | 3.0 | 3.3 | 3.3 | 4.8 | 4.0 | 1.8 | 1.3 | .8 | 2.0 | 2.1 | 2.5 |
| 22 | 2.9 | 3.1 | 3.3 | 3.3 | 4.9 | 3.9 | 1.8 | 1.3 | 1.3 | 2.0 | 2.1 | 2.5 |
| 23 | 3.0 | 3.0 | 3.2 | 3.3 | 4.8 | 3.9 | 1.7 | 1.4 | 1.4 | 2.0 | 2.1 | 2.5 |
| 24 | 3.1 | 3.0 | 3.2 | 3.4 | 4.4 | 3.7 | 1.5 | 1.5 | 1.1 | 2.0 | 2.2 | 2.5 |
| 25 | 3.0 | 3.0 | 3.1 | 3.6 | 4.5 | 3.6 | 1.5 | 1.5 | 1.4 | 2.0 | 2.2 | 2.4 |
| 26 | 2.9 | 3.0 | 3.2 | 4.1 | 4.6 | 3.5 | 1.5 | 1.0 | 1.2 | 2.0 | 2.2 | 2.4 |
| 27 | 2.9 | 3.1 | 3.4 | 4.2 | 4.6 | 3.5 | 1.5 | 1.2 | 1.3 | 2.0 | 2.2 | 2.7 |
| 28 | 2.9 | 3.1 | 3.4 | 4.5 | 4.5 | 3.4 | 1.5 | 1.0 | 1.3 | 2.0 | 2.3 | 2.7 |
| 29 | 2.9 | ....... | 3.4 | 4.7 | 4.4 | 3.2 | 1.5 | .8 | 1.4 | 2.0 | 2.3 | 2.6 |
| 30 | 2.9 | ....... | 3.4 | 4.8 | 4.3 | 3.2 | 1.5 | 1.0 | 1.4 | 2.0 | 2.2 | 2.5 |
| 31 | 2.9 | ....... | 3.3 | ....... | 4.3 | ....... | 1.4 | .7 | ....... | 2.0 | ....... | 2.5 |

*Station rating table for Carson River near Empire, Nev., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 3 | 2.10 | 77 | 3.10 | 313 | 4.10 | 765 |
| 1.10 | 4 | 2.20 | 93 | 3.20 | 347 | 4.20 | 825 |
| 1.20 | 6 | 2.30 | 110 | 3.30 | 384 | 4.30 | 889 |
| 1.30 | 8 | 2.40 | 129 | 3.40 | 423 | 4.40 | 956 |
| 1.40 | 12 | 2.50 | 150 | 3.50 | 464 | 4.50 | 1,026 |
| 1.50 | 16 | 2.60 | 173 | 3.60 | 508 | 4.60 | 1,100 |
| 1.60 | 23 | 2.70 | 197 | 3.70 | 554 | 4.70 | 1,180 |
| 1.70 | 31 | 2.80 | 223 | 3.80 | 603 | 4.80 | 1,260 |
| 1.80 | 40 | 2.90 | 251 | 3.90 | 654 | 4.90 | 1,345 |
| 1.90 | 51 | 3.00 | 281 | 4.00 | 708 | 5.00 | 1,430 |
| 2.00 | 63 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is well defined between gage heights 1.7 feet and 5.4 feet.

*Estimated monthly discharge of Carson River near Empire, Nev., for 1905.*

[Drainage area, 988 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 404 | 223 | 267 | 16,420 | 0.270 | 0.311 |
| February | 384 | 251 | 300 | 16,660 | .304 | .317 |
| March | 423 | 313 | 366 | 22,500 | .370 | .427 |
| April | 1,260 | 384 | 561 | 33,380 | .568 | .634 |
| May | 1,430 | 464 | 929 | 57,120 | .940 | 1.08 |
| June | 1,100 | 347 | 728 | 43,320 | .737 | .822 |
| July | 347 | 12 | 95.4 | 5,866 | .097 | .112 |
| August | 16 | 0 | 6.9 | 424 | .0070 | .0081 |
| September | 12 | 0 | 5.5 | 327 | .0056 | .0062 |
| October | 63 | 12 | 45.8 | 2,816 | .046 | .053 |
| November | 110 | 63 | 78.1 | 4,647 | .079 | .088 |
| December | 197 | 93 | 135 | 8,301 | .137 | .158 |
| The year | 1,430 | 0 | 293 | 211,800 | .280 | 4.02 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## SUSAN RIVER BASIN.

### DESCRIPTION OF BASIN.

Susan River rises on the eastern slope of the Sierra Nevada in northeastern California, the rim of the basin having an elevation of 7,000 feet, flows eastward, and discharges into Honey Lake—one of the land-locked lakes of the Great Basin—at an elevation of about 4,000 feet.

The drainage basin is long and narrow, and though numerous small creeks enter the river from both the north and south there are no tributaries of any size. Willow Creek, which joins the stream about 12 miles below Susanville, is the most important.

In the upper reaches of the basin, at an elevation of about 6,000 feet, are numerous small lakes and this region has also good forest cover. Below Susanville, in the area surrounding Honey Lake, the soil deposit has considerable depth and is susceptible of high cultivation; elsewhere the basin is composed of lava rock with a thin covering of soil.

The summer flow of the stream is regulated by several small storage reservoirs, but these have inconsiderable capacity. There are, however, a number of good storage sites in the basin. The precipitation is mostly in the form of snow.

### SUSAN RIVER NEAR SUSANVILLE, CAL.

This station was established June 3, 1900. It is located about three-fourths of a mile southwest of Susanville, at the electric-light plant.

The channel is straight for 150 feet above and 250 feet below the cable. The right bank is high and not liable to overflow and is composed of clay covered with vegetation. The left bank is low, is liable to overflow, and is covered with a sparse growth of willows. The bed of the stream is of gravel and cobblestone and is permanent. A short distance above the station a small irrigating ditch, known as the Masten ditch, is taken out on the right bank. There is a flume near its head in which a gage has been placed.

Discharge measurements are made by means of a cable and car. The initial point for soundings is a post in the fence in line with the cable. The cable support on the left bank is 34.8 feet from the initial point for soundings.

The gage is read once each day by James Branham. When the station was first established a temporary gage was installed on the right bank. December 20, 1903, the station at the electric-light plant was reestablished and a new gage was set which was made to read 2 feet more than the original gage. The gage is referred to bench marks as follows: (1) A nail in the fence post which is used as the initial point for soundings; elevation, 11.35 feet. (2) A nail in the cable post; elevation, 9.00 feet. (3) A nail in the cottonwood tree to which the cable is attached; elevation, 10.00 feet. Elevations are above zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 51, p 408; 66, pp 115-116; 85, p 123; 100, pp 204-205; 133, p 339-346.
Discharge: 51, p 408; 66, p 116; 100, p 205; 133, p 340.
Discharge, monthly: 75, p 190; 133, p 341-342.
Gage heights: 51, p 408; 66, p 116; 85, p 124; 100, p 205; 133, p 340.
Rating table: 566, p 175; 133, p 341.

*Discharge measurements of Susan River near Susanville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 21 | J. Branham | 44 | 92 | 4.79 | 6.60 | 441 |
| May 12 | do | 29 | 48 | 3.27 | 5.40 | 157 |
| June 12 | do | 25 | 31 | 2.32 | 4.70 | 72 |
| June 25 | do | 24 | 18 | 1.66 | 4.20 | 30 |
| July 23 | do | 18 | 10.8 | 1.19 | 3.85 | 12.8 |
| August 29 | do | 14 | 8.1 | 0.85 | 3.75 | 6.9 |
| September 26 | do | 19 | 13.6 | 1.13 | 4.00 | 15.4 |

*Daily gage height, in feet, of Susan River near Susanville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.95 | 5.2 | 5.25 | 6.15 | 5.95 | 5.15 | 4.1 | 4.1 | 3.8 | 3.8 | 4.0 | 4.0 |
| 2 | 4.8 | 5.2 | 5.25 | 5.95 | 5.9 | 5.1 | 4.1 | 4.1 | 3.8 | 3.8 | 4.0 | 4.0 |
| 3 | 4.75 | 5.2 | 5.25 | 5.95 | 5.8 | 5.05 | 4.45 | 4.1 | 3.8 | 3.9 | 4.0 | 4.0 |
| 4 | 4.7 | 5.2 | 5.25 | 5.9 | 5.8 | 5.05 | 4.8 | 4.1 | 3.8 | 3.95 | 4.0 | 4.0 |
| 5 | 4.65 | 5.15 | 5.25 | 5.9 | 5.65 | 5.0 | 4.6 | 4.1 | 3.85 | 3.95 | 4.0 | 4.0 |
| 6 | 4.6 | 5.05 | 5.25 | 6.0 | 5.55 | 5.0 | 4.4 | 4.1 | 3.85 | 3.95 | 4.0 | 4.0 |
| 7 | 4.6 | 4.85 | 5.25 | 6.1 | 5.5 | 5.0 | 4.25 | 4.1 | 3.85 | 4.0 | 4.0 | 4.0 |
| 8 | 4.55 | 4.85 | 5.25 | 6.1 | 5.5 | 4.9 | 4.1 | 4.0 | 3.85 | 3.95 | 4.0 | 4.0 |
| 9 | 4.55 | 4.75 | 5.2 | 6.1 | 5.5 | 4.85 | 4.1 | 3.9 | 3.85 | 3.9 | 4.0 | 4.0 |
| 10 | 4.55 | 4.8 | 5.2 | 6.2 | 5.45 | 4.75 | 4.0 | 3.8 | 3.85 | 3.9 | 4.0 | 4.0 |
| 11 | 4.55 | 4.7 | 5.2 | 6.1 | 5.4 | 4.7 | 4.0 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 12 | 4.6 | 4.65 | 5.4 | 6.1 | 5.4 | 4.7 | 4.0 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 13 | 4.65 | 4.55 | 5.9 | 6.1 | 5.35 | 4.65 | 3.95 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 14 | 4.7 | 4.5 | 5.9 | 6.1 | 5.3 | 4.65 | 4.2 | 3.8 | 3.85 | 3.9 | 4.0 | 4.0 |
| 15 | 4.7 | 4.45 | 6.05 | 6.1 | 5.3 | 4.6 | 4.2 | 3.75 | 3.85 | 3.9 | 4.0 | 4.0 |
| 16 | 4.7 | 4.45 | 6.1 | 6.1 | 5.4 | 4.5 | 4.2 | 3.75 | 3.8 | 3.9 | 4.0 | 4.0 |
| 17 | 4.7 | 4.5 | 6.05 | 6.05 | 5.4 | 4.5 | 4.0 | 3.75 | 3.8 | 4.0 | 4.0 | 4.0 |
| 18 | 4.65 | 4.55 | 6.0 | 6.05 | 5.4 | 4.4 | 4.0 | 3.75 | 3.8 | 4.05 | 4.0 | 4.0 |
| 19 | 4.65 | 5.05 | 6.6 | 6.05 | 5.4 | 4.4 | 4.1 | 3.75 | 3.9 | 4.0 | 4.0 | 4.0 |
| 20 | 4.65 | 5.35 | 6.25 | 5.95 | 5.4 | 4.4 | 4.05 | 3.75 | 3.9 | 4.0 | 4.0 | 4.0 |
| 21 | 4.65 | 5.35 | 6.45 | 5.8 | 5.4 | 4.3 | 3.9 | 3.8 | 3.95 | 4.0 | 4.0 | 4.0 |
| 22 | 4.8 | 5.25 | 6.15 | 5.8 | 5.4 | 4.3 | 3.9 | 3.8 | 3.95 | 4.0 | 4.0 | 4.0 |
| 23 | 5.5 | 5.1 | 6.1 | 5.8 | 5.35 | 4.25 | 3.85 | 3.8 | 3.95 | 4.0 | 4.05 | 4.0 |
| 24 | 5.4 | 5.1 | 6.05 | 5.85 | 5.35 | 4.2 | 3.85 | 3.75 | 3.95 | 4.0 | 4.05 | 4.0 |
| 25 | 5.2 | 5.2 | 5.85 | 5.9 | 5.3 | 4.2 | 3.85 | 3.75 | 3.95 | 4.0 | 4.1 | 4.0 |
| 26 | 4.95 | 5.2 | 6.9 | 6.0 | 5.3 | 4.2 | 3.85 | 3.75 | 4.0 | 4.0 | 4.1 | 4.0 |
| 27 | 4.9 | 5.25 | 6.3 | 6.0 | 5.3 | 4.2 | 3.8 | 3.75 | 3.9 | 4.0 | 4.1 | 4.0 |
| 28 | 4.9 | 5.25 | 6.1 | 6.0 | 5.25 | 4.2 | 3.8 | 3.75 | 4.0 | 4.0 | 4.05 | 4.0 |
| 29 | 4.85 | ....... | 6.0 | 6.0 | 5.25 | 4.15 | 3.75 | 3.8 | 3.95 | 4.0 | 4.05 | 4.0 |
| 30 | 4.8 | ....... | 6.1 | 6.0 | 5.2 | 4.15 | 3.75 | 3.8 | 3.9 | 4.0 | 4.0 | 4.0 |
| 31 | 4.8 | ....... | 6.0 | ....... | 5.2 | ....... | 4.1 | 3.8 | ....... | 4.0 | ....... | 4.0 |

*Station rating table for Susan River near Susanville, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.75 | 7 | 4.60 | 59 | 5.40 | 152 | 6.20 | 307 |
| 3.80 | 9 | 4.70 | 68 | 5.50 | 168 | 6.30 | 331 |
| 3.90 | 13 | 4.80 | 77 | 5.60 | 185 | 6.40 | 356 |
| 4.00 | 18 | 4.90 | 87 | 5.70 | 203 | 6.50 | 382 |
| 4.10 | 24 | 5.00 | 98 | 5.80 | 222 | 6.60 | 410 |
| 4.20 | 30 | 5.10 | 110 | 5.90 | 242 | 6.70 | 440 |
| 4.30 | 37 | 5.20 | 123 | 6.00 | 262 | 6.80 | 470 |
| 4.40 | 44 | 5.30 | 137 | 6.10 | 284 | 6.90 | 500 |
| 4.50 | 51 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904-5, and is well defined.

*Estimated monthly discharge of Susan River near Susanville, Cal., for 1905.*

[Drainage area, 256 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 168 | 55 | 76.9 | 4,728 | 0.300 | 0.346 |
| February | 144 | 48 | 96.9 | 5,382 | .379 | .395 |
| March | 500 | 123 | 234 | 14,390 | .914 | 1.05 |
| April | 307 | 222 | 264 | 15,710 | 1.03 | 1.15 |
| May | 252 | 123 | 160 | 9,838 | .625 | .721 |
| June | 116 | 27 | 61.3 | 3,648 | .239 | .267 |
| July | 77 | 7 | 23.4 | 1,439 | .091 | .105 |
| August | 24 | 7 | 12.1 | 744 | .047 | .054 |
| September | 18 | 9 | 12.3 | 732 | .048 | .054 |
| October | 21 | 9 | 15.7 | 965 | .061 | .070 |
| November | 24 | 18 | 19.0 | 1,131 | .074 | .083 |
| December | 18 | 18 | 18.0 | 1,107 | .070 | .081 |
| The year | 500 | 7 | 82.8 | 59,810 | .323 | 4.38 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## WILLOW CREEK AT MERRILLVILLE, CAL.

Willow Creek rises from springs directly under Eagle Lake, presumably seepage from Eagle Lake, which has no surface outlet; it flows southward, joining Susan River about 12 miles below Susanville. Its only tributary of importance is Petes Creek, which drains a large area in the eastern portion of the basin. The drainage area of the main stream has good timber covering, while that tributary to Petes Creek is barren of timber. The entire basin is composed of lava rock with a light covering of soil, and contains large stretches of barren table-lands with scattered peaks of volcanic origin. There is a large area of cultivated land along Willow Creek above the gaging station at Standish and considerable water is diverted for irrigation of lands adjoining the stream.

The gaging station at Merrillville was established June 18, 1904. It is located near the head of the creek, at the old bridge, 100 feet above the present wagon bridge, on the road from Merrillville to Eagle Lake.

The channel is straight above and below the bridge for a distance of 100 feet. The banks are low, but as there is very little fluctuation in the discharge of the creek, they are not subject to overflow. The bed of the stream is composed of gravel, and is comparatively permanent.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank of the stream. The distance across the creek is marked on the footbridge at intervals of 2 feet.

The gage, which is read once each day by R. W. Hurlburt, is a 2 by 4 inch vertical rod fastened to the left end of the bridge.

A description of this station, gage height, discharge data, and rating table are contained in Water-Supply Paper No. 133, of the United States Geological Survey, pp. 339–341.

*Daily gage height, in feet, of Willow Creek at Merrillville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 1.1 | 0.95 | 1.1 | 0.9 | 0.95 | 0.9 | 0.95 | 1.0 | 1.1 | 1.3 | 1.25 |
| 2 | 1.05 | 1.1 | 1.0 | 1.05 | .9 | .95 | .9 | .95 | 1.0 | 1.1 | 1.25 | 1.3 |
| 3 | 1.0 | 1.1 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 4 | 1.0 | 1.05 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 5 | 1.0 | 1.1 | .95 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 6 | 1.0 | 1.05 | .95 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.2 | 1.2 | 1.3 |
| 7 | 1.0 | 1.0 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.3 | 1.2 | 1.3 |
| 8 | 1.0 | 1.0 | 1.05 | 1.0 | .95 | 1.0 | .9 | .95 | 1.0 | 1.2 | 1.2 | 1.3 |
| 9 | 1.0 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .9 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 10 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .95 | .95 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 11 | 1.0 | 1.0 | 1.0 | .95 | 1.05 | .95 | .95 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 12 | 1.0 | 1.0 | 1.0 | .95 | 1.1 | .95 | 1.05 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 13 | 1.0 | 1.0 | 1.05 | 1.0 | 1.05 | .95 | 1.05 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 14 | 1.05 | 1.0 | .95 | 1.0 | 1.0 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 15 | 1.05 | .95 | 1.05 | 1.0 | .95 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 16 | 1.05 | 1.0 | 1.1 | 1.0 | .9 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 17 | 1.05 | 1.0 | 1.1 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 18 | 1.05 | 1.0 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 19 | 1.05 | 1.25 | 1.1 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 20 | 1.0 | 1.15 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 21 | 1.05 | 1.05 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 22 | 1.1 | 1.05 | 1.05 | 1.0 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 23 | 1.1 | 1.05 | 1.05 | .9 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 24 | 1.1 | 1.0 | 1.0 | .9 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 25 | 1.05 | 1.0 | 1.0 | .95 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 26 | 1.0 | 1.05 | 1.1 | .95 | 1.0 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 27 | 1.0 | 1.0 | 1.1 | .95 | 1.0 | .95 | .95 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 |
| 28 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .95 | .95 | 1.0 | 1.15 | 1.2 | 1.25 | 1.3 |
| 29 | 1.0 | ........ | 1.1 | .9 | .95 | .95 | .95 | 1.0 | 1.2 | 1.2 | 1.25 | 1.3 |
| 30 | 1.0 | ........ | 1.05 | .9 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.25 | 1.3 |
| 31 | 1.0 | ........ | 1.05 | ........ | .95 | ........ | .95 | 1.0 | ........ | 1.25 | ........ | 1.3 |

*Station rating table for Willow Creek at Merrillville, Cal., from July 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 16 | 1.10 | 20 | 1.20 | 22 | 1.30 | 24 |
| 1.00 | 18 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1904. It is fairly well defined.

*Estimated monthly discharge of Willow Creek at Merrillville, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 20 | 18 | 18.5 | 1,138 |
| February | 23 | 17 | 18.8 | 1,044 |
| March | 20 | 17 | 18.6 | 1,144 |
| April | 20 | 16 | 17.6 | 1,047 |
| May | 20 | 16 | 17.1 | 1,051 |
| June | 18 | 16 | 17.0 | 1,012 |
| July | 19 | 16 | 16.9 | 1,039 |
| August | 18 | 17 | 17.7 | 1,088 |
| September | 22 | 18 | 18.7 | 1,113 |
| October | 24 | 20 | 21.9 | 1,347 |
| November | 24 | 22 | 22.2 | 1,321 |
| December | 24 | 23 | 24.0 | 1,476 |
| The year | 24 | 16 | 19.1 | 13,820 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## WILLOW CREEK NEAR STANDISH, CAL.

This station was originally established June 4, 1900. It was reestablished January 1, 1905, and discontinued December 31, 1905. It is located at the bridge on the road from Susanville to Hot Springs and is about 1½ miles above the junction of the creek with Susan River. It is about 4 miles west of north from Standish.

The channel is straight for 300 feet above and 250 feet below the station. The right bank is rather low and is subject to overflow at extreme high water; the left bank is high and not liable to overflow. The stream bed is sandy and liable to shift somewhat.

Discharge measurements are made from the bridge. The initial point for soundings is on the end of the bridge on the left bank, the bridge being marked at 5-foot intervals across the stream.

The gage, which is read once each day by T. E. Ravenscroft, a farmer who lives near the station, is a 4 by 4-inch vertical timber and is fastened to the left abutment of the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 407; 66, p 115.
Discharge: 51, p 407.
Gage heights: 51, p 407; 66, p 115.

*Discharge measurements of Willow Creek near Standish, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 24 | J. Branham | 57 | 117 | 0.80 | 6.15 | 94 |
| January 29 | do | 57 | 87 | .79 | 5.35 | 69 |
| February 26 | do | 57 | 105 | .79 | 5.75 | 83 |
| April 23 | do | 32 | 21 | .95 | 4.00 | 20 |
| November 19 | do | 57 | 56 | .61 | 4.80 | 34 |

*Daily gage height, in feet, of Willow Creek near Standish, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.6 | 6.8 | 5.0 | 5.5 | 4.0 | 4.0 | 3.0 | 4.0 | 4.2 | 5.0 | 5.0 | 5.0 |
| 2 | 6.6 | 6.7 | 4.8 | 5.3 | 4.0 | 4.0 | 3.0 | 4.0 | 4.5 | 4.8 | 5.1 | 5.3 |
| 3 | 5.0 | 5.9 | 4.0 | 5.0 | 4.0 | 4.0 | 3.0 | 4.0 | 4.4 | 4.6 | 5.0 | 5.2 |
| 4 | 5.0 | ....... | 4.0 | 5.0 | 4.0 | 4.0 | 6.0 | 4.0 | 4.4 | 4.3 | 5.0 | 5.0 |
| 5 | 4.6 | 5.8 | 4.0 | 4.8 | 4.0 | 4.0 | 5.8 | 4.0 | 4.4 | 4.0 | 5.0 | 5.1 |
| 6 | 4.6 | 6.0 | 4.4 | 4.5 | 4.0 | 4.0 | 4.8 | 4.0 | 4.4 | 4.0 | 5.1 | 5.0 |
| 7 | 4.6 | 6.0 | 4.4 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.4 | 4.0 | 5.2 | 5.2 |
| 8 | 4.6 | 5.8 | 4.4 | 4.0 | 4.0 | 4.2 | 4.0 | 4.0 | 4.4 | 4.2 | 5.0 | 4.1 |
| 9 | 4.6 | 5.6 | 4.0 | 4.0 | 4.0 | 4.1 | 4.0 | 4.0 | 4.4 | 4.2 | 5.0 | 4.1 |
| 10 | 4.6 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 5.2 | 4.4 |
| 11 | 4.6 | 5.0 | 4.4 | 4.0 | 4.2 | 4.0 | 4.0 | 4.2 | 4.0 | 4.1 | 5.1 | 4.4 |
| 12 | 4.7 | 5.0 | 4.0 | 3.8 | 4.2 | 4.0 | 6.0 | 4.0 | 4.0 | 4.0 | 4.6 | 4.4 |
| 13 | 4.7 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.0 | 4.0 | 4.0 | 4.4 | 4.3 |
| 14 | 4.7 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 6.0 | 4.0 | 4.4 | 4.5 |
| 15 | 5.8 | 4.6 | 4.4 | 4.0 | 4.0 | 4.0 | 5.0 | 4.0 | 5.8 | 4.0 | 4.4 | 4.1 |
| 16 | 5.8 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 5.0 | 4.1 | 4.6 | 4.1 |
| 17 | 6.0 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 5.0 | 4.5 | 4.8 | 4.3 |
| 18 | 6.0 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.2 | 5.0 | 4.5 | 4.8 | 4.3 |
| 19 | 6.4 | 5.1 | 5.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.2 | 5.0 | 4.5 | 5.0 | 4.3 |
| 20 | 6.35 | 6,0 | 5.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.6 | 5.0 | 4.5 | 5.0 | 4.3 |
| 21 | 6.0 | 7.8 | 5.2 | 4.0 | 4.1 | 4.0 | 6.0 | 4.5 | 4.8 | 4.5 | 4.8 | 4.0 |
| 22 | 7.6 | 7.8 | 5.2 | 4.0 | 4.1 | 4.0 | 5.0 | 4.6 | 4.8 | 4.5 | 4.6 | 5.0 |
| 23 | 7.8 | 7.0 | 5.0 | 4.0 | 4.0 | 4.0 | 5.0 | 4.2 | 4.8 | 5.0 | 4.6 | 5.0 |
| 24 | 6.0 | 6.2 | 4.8 | 4.0 | 4.0 | 4.0 | 4.8 | 4.0 | 4.6 | 5.1 | 4.5 | 5.2 |
| 25 | 6.0 | 6.0 | 4.6 | 4.0 | 4.0 | 4.0 | 4.1 | 4.0 | 4.5 | 5.2 | 4.4 | 5.0 |
| 26 | 5.8 | 6.3 | 5.3 | 4.0 | 4.0 | 6.2 | 4.0 | 4.2 | 5.0 | 5.2 | 4.8 | 5.2 |
| 27 | 5.6 | 5.0 | 5.0 | 4.0 | 4.0 | 5.0 | 4.0 | 4.2 | 6.0 | 5.1 | 4.8 | 5.3 |
| 28 | 5.6 | 5.0 | 5.0 | 4.0 | 3.8 | 4.0 | 4.0 | 4.2 | 5.8 | 5.5 | 5.0 | 5.3 |
| 29 | 5.7 | ....... | 5.0 | 4.0 | 3.8 | 4.0 | 4.0 | 4.2 | 5.8 | 5.2 | 5.0 | 5.3 |
| 30 | 5.0 | ....... | 5.0 | 4.0 | 3.8 | 3.6 | 4.0 | 4.3 | 5.0 | 5.0 | 5.0 | 5.3 |
| 31 | 5.6 | ....... | 5.5 | ....... | ....... | ....... | 4.0 | 4.2 | ....... | 5.0 | ....... | 5.3 |

*Station rating table for Willow Creek near Standish, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.60 | 10 | 4.70 | 34 | 5.80 | 86 | 6.90 | 165 |
| 3.70 | 11 | 4.80 | 37 | 5.90 | 92 | 7.00 | 173 |
| 3.80 | 13 | 4.90 | 41 | 6.00 | 98 | 7.10 | 181 |
| 3.90 | 15 | 5.00 | 45 | 6.10 | 105 | 7.20 | 189 |
| 4.00 | 17 | 5.10 | 49 | 6.20 | 112 | 7.30 | 197 |
| 4.10 | 19 | 5.20 | 54 | 6.30 | 119 | 7.40 | 205 |
| 4.20 | 21 | 5.30 | 59 | 6.40 | 126 | 7.50 | 213 |
| 4.30 | 23 | 5.40 | 64 | 6.50 | 133 | 7.60 | 221 |
| 4.40 | 25 | 5.50 | 69 | 6.60 | 141 | 7.70 | 229 |
| 4.50 | 28 | 5.60 | 74 | 6.70 | 149 | 7.80 | 238 |
| 4.60 | 31 | 5.70 | 80 | 6.80 | 157 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905 between gage heights 4 feet and 6.15 feet. It is not well defined.

*Estimated monthly discharge of Willow Creek near Standish, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 238 | 31 | 80.4 | 4,944 |
| February | 238 | 31 | 89.4 | 4,965 |
| March | 69 | 17 | 33.5 | 2,060 |
| April | 69 | 17 | 22.9 | 1,363 |
| May | 21 | 13 | 17.0 | 1,045 |
| June | 112 | 10 | 21.1 | 1,256 |
| July | 98 | 0 | 46.2 | 2,841 |
| August | 31 | 17 | 19.6 | 1,205 |
| September | 98 | 17 | 41.0 | 2,440 |
| October | 69 | 17 | 31.8 | 1,955 |
| November | 54 | 25 | 39.6 | 2,356 |
| December | 59 | 17 | 38.7 | 2,380 |
| The year | 238 | 0 | 40.1 | 28,810 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction.

## OWENS RIVER DRAINAGE BASIN.

Owens River has its source in the Sierra Nevada, in eastern California, and flows southeastward, parallel with this range, finally discharging its waters into Owens Lake. This basin has a length from north to south of approximately 150 miles and a width of from 20 to 25 miles. It lies between the Sierra Nevada on the west and the White Mountains on the east. Practically the entire flow of this river is derived from the Sierra Nevada, as it drains the eastern slope of this range from Mount Lyell, on the north, to a point some distance below Mount Whitney, on the south. The White Mountains furnish no water for this stream except in times of very heavy rain storms, which seldom occur on this range. Numerous tributaries enter Owens River from the west, which have their sources in the high elevations of the Sierra Nevada, extending from the northern to the southern limits of this basin. The topography of that portion of the Sierra Nevada which is drained by this stream is extremely rough and precipitous, the mountains rising abruptly from Owens Valley to elevations of 13,000 to 14,000 feet. The rock formation is of granite, with very little soil covering, and sparse timber growth. Numerous lakes and marshes lie in the upper reaches of this portion of the drainage basin. Owens River, a short distance below its source, enters a flat, swampy country known as Long Valley, where a considerable quantity of its flow is used for the irrigation of meadow lands for stock raising. This water returns to the river channel at the lower end of Long Valley, where the stream enters a deep, narrow gorge with heavy grade. As the river breaks from this canyon it enters Owens Valley, through which it flows for about 80 miles, finally discharging into Owens Lake. The gaging station at Round Valley is located at the lower end of this canyon. Below this point numerous diversions are made for the irrigation of land in Owens Valley, where the soil is extensively cultivated, and large areas are used for raising hay and grain. This country is particularly adapted to stock raising, which is carried on to a large extent throughout the valley. There are numerous opportunities for the construction of storage reservoirs within this basin, both on the main stream and on the upper reaches of its tributaries, though none have been constructed as yet. The precipitation is extremely light within the area of the basin, except on the high elevations of the Sierra Nevada, where there is a heavy fall of snow. The melting of the snow in spring and summer feeds the numerous tributaries of this river, insuring a continued flow throughout the year.

The results of data collected in Owens River Valley are contained in Water-Supply Paper No. 177, which presents the results of all the hydrographic data collected in the State of California during 1905.

## MINOR GREAT BASIN DRAINAGE.

### PRINCIPAL STREAMS.

The minor Great Basin drainage includes large areas in Oregon, Nevada, Utah, and California, in which the water supply is very limited, most of the streams being intermittent.

The work of the United States Geological Survey on this drainage in 1905 covered only the collection of data concerning streams in Oregon, which are here classified by the lakes into which they flow, as follows: Silvies River, discharging into Malheur Lake; Silver Creek, into Harney Lake; Silver Creek, Bridge Creek, and Bear Creek, into Silver Lake; Summer Lake and Ana River, into Summer Lake; and Chewaucan River, into Abert Lake.

### MALHEUR LAKE BASIN.

#### MALHEUR LAKE AT THE NARROWS, OREGON.

This station was established May 14, 1903. It is located at the highway bridge across The Narrows. The station is maintained for the purpose of obtaining data in regard to the fluctuations of the lake, which has no outlet.

The gage is a 1 by 4 inch board, 10 feet long, fastened to a telegraph pole. It is read from the bridge once each week by R. J. Haines, the postmaster. The bench mark is a United States Geological Survey standard iron bench-mark post, set at the east end of the bridge, on the south side of the road, near the fence and about 200 feet from the gage; its elevation is 8.20 feet above the zero of the gage and 4,088 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 429; 133, pp 344–345.
Gage heights: 100, p 430; 133, p 345.

*Gage height, in feet, of Malheur Lake, at The Narrows, Oregon, for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 2 | | | | 4.2 | | | 2.7 |
| 4 | | | | | | 3.0 | |
| 5 | | | 5.0 | | | | |
| 7 | | | | | 3.45 | | |
| 8 | | 5.65 | | | | | |
| 9 | | | | 4.0 | | | 2.65 |
| 11 | | | | | | 2.9 | |
| 12 | | | 4.8 | | | | |
| 14 | | | | | 3.3 | | |
| 15 | | 5.5 | | | | | |
| 16 | 5.7 | | | 3.85 | | | 2.65 |
| 18 | | | | | | 2.8 | |
| 19 | | | 4.6 | | | | |
| 21 | | | | | 3.2 | | |
| 22 | | 5.35 | | | | | |
| 23 | | | | 3.6 | | | |
| 25 | | | | | | 2.75 | |
| 26 | | | 4.4 | | | | |
| 28 | | | | | 3.1 | | |
| 29 | | 5.2 | | | | | |
| 30 | | | | 3.5 | | | |

## SILVIES RIVER NEAR SILVIES, OREG.

Silvies River rises at Soda Spring, in southern Grant County, Oreg., flows southwest, then southeast, and discharges into the north end of Malheur Lake.

A temporary station was established near Silvies, Oreg., May 8, 1903, and gage heights were read by John Craddock from May 8 to June 26, 1903. One discharge measurement was made at the temporary station. June 16, 1903, a permanent gage was established at the proposed dam site one-half mile below the temporary gage, 2 miles west of the stage road, and three-fourths of a mile below the mouth of Trout Creek. There is a dam 1½ mile upstream.

The channel is straight for 150 feet above and 200 feet below the station. The right bank is low, and will overflow at high water for a considerable distance; the left bank is high and rocky, and not liable to overflow. The bed of the stream is composed of gravel, is free from vegetation, and shifts somewhat. All the water passes beneath the cable at all stages.

Discharge measurements are made from a five-eighth inch galvanized-iron cable, with a span of 494 feet, located 75 feet downstream from the gage. It is supported in the center. The initial point for soundings is the zero of the tagged wire, 29 feet from the cable support.

The gage is an inclined 2 by 6 inch plank on the left bank. No bench marks have been established.

This station was not maintained regularly during 1905, but a few discharged measurements were made when measurements were made at Burns, a station on the same stream below this point.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 100, p 434; 133, pp 345–346.
Discharge: 100, p 434; 133, p 346.
Discharge, monthly: 100, p 436; 133, p 348.
Gage heights: 100, p 435; 133, p 347.
Rating table: 100, p 435; 133, p 347–348.

*Discharge measurements of Silvies River, near Silvies, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 23 | M. L. Lewis | 47 | 174 | 0.96 | 4.55 | 166 |
| April 13 | do | 47 | 165 | .95 | 4.65 | 156 |
| April 26 | do | 48 | 178 | 1 08 | 4.82 | 193 |
| May 25 | do | 43 | 135 | .70 | 3.90 | 94 |
| October 24 | do | 18 | 6.5 | .63 | 2.00 | 4.1 |

## SILVIES RIVER NEAR BURNS, OREG.

This station was established as a temporary station May 10, 1903, and was made permanent August 14, 1903. A new gage and a cable for discharge measurements were installed January 19, 1904. The station is located about 10 miles above Burns, Oreg.

The channel is straight for 75 feet above and below the cable. The right bank is low, and is liable to overflow for a considerable distance. The left bank is high and rocky, and will not overflow. Both banks have been cleared of brush. At the gage the bed of the stream is composed of clean sand and gravel. There is but one channel at low water; at high stages there are two or more channels. All the waters passes beneath the cable at all stages.

Discharge measurements are made from a five-eighths inch galvanized-iron cable, with a span of 390 feet, located at Lampshir's place, 1 mile above the gage. In addition to the timber supports at the ends, the cable is supported at a point 167 feet from the initial point for soundings by a tree 10 inches in diameter. The initial point for soundings is the zero of the tagged wire, 22½ feet from the lower end of the turnbuckle. At low water, when the current is sluggish, discharge measurements are made by wading.

The gage, which is read once each day by Leonia Parker, is located 10 feet below the bridge near Parker's house. It is in two sections, both consisting of 2 by 6 inch timbers supported by a frame secured to the bank. The lower section is inclined and reads from 2 to 12.6 feet; the upper section is vertical and reads from 12.7 to 17 feet. The new gage has the same datum as the old one which it replaced. The bench mark is the highest point of a large rock on the right bank, directly across the river from the gage, from which it is 135 feet distant; elevation above zero of gage, 19.76 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 431–432; 133, pp 348–349.
Discharge: 100, p 432; 133, p 349.
Discharge, monthly: 100, p 433; 133, p 351.
Gage heights: 100, pp 432–433; 133, p 350.
Rating table: 100, p 433; 133, p 351.

*Discharge measurements of Silvies River near Burns, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 21 | M. L. Lewis | 56 | 476 | 0.95 | 7.55 | 450 |
| April 11 | do | 55 | 466 | .87 | 7.70 | 405 |
| April 25 | do | 55 | 438 | .80 | 6.65 | 352 |
| May 17[a] | do | 57 | 520 | .36 | 4.75 | 190 |
| July 18 | Ivan Landes | 28 | 22 | .89 | 2.54 | 20 |
| October 3 | M. L. Lewis | 25 | 17 | .78 | 2.40 | 13.4 |

[a] Water at cable backed up by dam one-half mile below, but no effect on gage height.

*Daily gage height, in feet, of Silvies River near Burns, Oreg., for 1905.*

| Day. | Jan. | Feb. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 2.9 | ........ | 6.8 | 3.8 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 2 | 3.9 | 2.9 | ........ | 6.5 | 3.8 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 3 | 3.4 | 2.9 | ........ | 6.3 | 3.9 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 4 | 3.3 | 2.9 | ........ | 6.25 | 3.9 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 5 | 3.1 | 2.9 | ........ | 6.2 | 3.9 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 6 | 2.9 | 2.9 | ........ | 6.0 | 3.9 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 7 | 2.8 | ........ | ........ | 5.9 | 3.9 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 8 | 2.7 | ........ | ........ | 5.2 | 3.8 | 2.6 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 |
| 9 | 2.7 | ........ | 8.3 | 5.3 | 3.8 | 2.6 | 2.35 | 2.3 | 2.4 | 2.5 | 2.5 |
| 10 | 2.7 | ........ | 8.0 | 5.4 | 3.8 | 2.6 | 2.35 | 2.3 | 2.4 | 2.5 | 2.5 |
| 11 | 2.7 | ........ | 7.75 | 5.6 | 3.6 | 2.6 | 2.35 | 2.3 | 2.4 | 2.5 | 2.5 |
| 12 | 2.7 | ........ | 7.35 | 5.6 | 3.5 | 2.6 | 2.3 | 2.3 | 2.4 | 2.5 | 2.5 |
| 13 | 2.7 | ........ | 7.15 | 5.6 | 3.4 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.5 |
| 14 | 2.7 | ........ | 7.05 | 5.5 | 3.4 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.5 |
| 15 | ........ | ........ | 6.65 | 5.0 | 3.4 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.5 |
| 16 | ........ | ........ | 6.65 | 4.9 | 3.3 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.5 |
| 17 | ........ | ........ | 6.9 | 4.8 | 3.3 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.45 |
| 18 | ........ | ........ | 7.0 | 4.4 | 3.2 | 2.6 | 2.3 | 2.3 | 2.4 | 2.55 | 2.45 |
| 19 | ........ | ........ | 7.0 | 4.2 | 3.2 | 2.55 | 2.3 | 2.3 | 2.4 | 2.55 | 2.4 |
| 20 | ........ | ........ | 7.0 | 4.2 | 3.0 | 2.55 | 2.3 | 2.3 | 2.4 | 2.5 | 2.4 |
| 21 | ........ | ........ | 7.2 | 4.2 | 3.0 | 2.5 | 2.3 | 2.3 | 2.4 | 2.5 | 2.4 |
| 22 | ........ | ........ | 7.3 | 4.2 | 2.9 | 2.5 | 2.3 | 2.3 | 2.4 | 2.5 | 2.4 |
| 23 | ........ | ........ | 7.15 | 4.2 | 2.8 | 2.55 | 2.3 | 2.3 | 2.4 | 2.5 | 2.4 |

*Daily gage height, in feet, of Silvies River near Burns, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | | | 7.0 | 4.1 | 2.8 | 2.55 | 2.3 | 2.3 | 2.4 | 2.5 | 2.4 |
| 25 | | | 7.2 | 4.1 | 2.8 | 2.5 | 2.3 | 2.3 | 2.45 | 2.5 | 2.4 |
| 26 | | | 7.3 | 4.0 | 2.8 | 2.4 | 2.3 | 2.3 | 2.5 | 2.5 | 2.4 |
| 27 | | | 7.5 | 4.0 | 2.8 | 2.4 | 2.3 | 2.3 | 2.5 | 2.5 | 2.4 |
| 28 | | | 7.5 | 3.9 | 2.8 | 2.4 | 2.3 | 2.3 | 2.5 | 2.5 | 2.4 |
| 29 | 2.9 | | 7.3 | 3.8 | 2.8 | 2.4 | 2.3 | 2.3 | 2.5 | 2.5 | 2.4 |
| 30 | 2.9 | | 6.8 | 3.8 | 2.8 | 2.4 | 2.3 | 2.4 | 2.5 | 2.5 | 2.4 |
| 31 | 2.9 | | | 3.8 | | 2.4 | 2.3 | | 2.5 | | 2.4 |

**Note.**—Ice conditions are known to exist frequently during the winter months.

*Station rating table for Silvies River near Burns, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.30 | 9 | 3.90 | 116 | 5.40 | 242 | 6.90 | 376 |
| 2.40 | 13 | 4.00 | 124 | 5.50 | 250 | 7.00 | 385 |
| 2.50 | 18 | 4.10 | 132 | 5.60 | 259 | 7.10 | 394 |
| 2.60 | 23 | 4.20 | 140 | 5.70 | 268 | 7.20 | 404 |
| 2.70 | 29 | 4.30 | 148 | 5.80 | 277 | 7.30 | 414 |
| 2.80 | 35 | 4.40 | 156 | 5.90 | 286 | 7.40 | 424 |
| 2.90 | 42 | 4.50 | 165 | 6.00 | 295 | 7.50 | 434 |
| 3.00 | 49 | 4.60 | 173 | 6.10 | 304 | 7.60 | 444 |
| 3.10 | 56 | 4.70 | 181 | 6.20 | 313 | 7.70 | 454 |
| 3.20 | 63 | 4.80 | 190 | 6.30 | 322 | 7.80 | 464 |
| 3.30 | 70 | 4.90 | 198 | 6.40 | 331 | 7.90 | 474 |
| 3.40 | 77 | 5.00 | 207 | 6.50 | 340 | 8.00 | 484 |
| 3.50 | 85 | 5.10 | 216 | 6.60 | 349 | 8.10 | 494 |
| 3.60 | 92 | 5.20 | 224 | 6.70 | 358 | 8.20 | 504 |
| 3.70 | 100 | 5.30 | 233 | 6.80 | 367 | 8.30 | 514 |
| 3.80 | 108 | | | | | | |

**Note.**—The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during the year. It is well defined between gage heights 2.4 feet and 7.5 feet.

*Estimated monthly discharge of Silvies River near Burns, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January (17 days) | 116 | 29 | 47.7 | 1,608 |
| February 1-6 | 42 | 42 | 42.0 | 500 |
| April 9-30 | 514 | 353 | 408 | 17,800 |
| May | 367 | 108 | 205 | 12,600 |
| June | 116 | 35 | 73.8 | 4,391 |
| July | 35 | 13 | 22.9 | 1,408 |
| August | 13 | 9 | 10.2 | 627 |
| September | 13 | 9 | 9.1 | 542 |
| October | 18 | 13 | 14.0 | 861 |
| November | 20 | 18 | 18.5 | 1,101 |
| December | 18 | 13 | 15.7 | 965 |
| The period | | | | 42,400 |

**Note.**—Open-channel rating table applied to the winter months without correction. January and February estimates subject to considerable error.

## HARNEY LAKE BASIN.

### SILVER CREEK, NEAR RILEY, OREG.

Silver Creek rises in the extreme northwestern part of Harney County, Oreg., and flows southeastward into the north end of Harney Lake.

The gaging station was established April 19, 1904. It is located 12 miles above Riley, Oreg., on the Burns-Shaniko stage line, and is 6 miles below the proposed reservoir site on Silver Creek.

The channels are straight for about 80 feet above and 50 feet below the station. There are three channels at high water and four or more at extreme floods. Both banks are low, covered with sagebrush, and subject to overflow. The bed of the stream is composed of sandy clay, is free from vegetation, and is shifting.

Discharge measurements are made from the three bridges over the three channels of the stream, in the line with the gage, and at high stages an additional slough is measured by wading. The initial point for soundings is the west end of the floor at each of the bridges.

The gage, which was read during 1905 by R. M. Cantrell and Miss Amy Bradford, is located at bridge No. 3, crossing the east or main channel of the creek. It is a plain staff gage, attached vertically to timbers on the lower side of the bridge at the left bank. From April 19 to September 10, 1904, when the permanent gage was established, readings were obtained by measuring down to the water surface from a mark on the bridge floor with a rod so graduated as to give gage readings direct. The bench mark is a United States Geological Survey standard iron bench-mark post on the north side of the road in front of the house of the observer. It is 20.19 feet above the zero of the gage and 4,345 feet above sea level, datum H. The top of the floor of bridge No. 1 at the 21-foot mark is 4,339.87 feet above sea level and 15.06 feet above the zero of the gage. The top of the floor of bridge No. 2 at the 20-foot mark is 4,338.69 feet above sea level and 13.88 feet above the zero of the gage. The top of the floor of bridge No. 3 at the 30-foot mark is 4,339.81 feet above sea level and 15.00 feet above the zero of the gage.

A description of this station, gage height, and discharge data, and rating table are contained in Water-Supply Paper No. 133 of the United States Geological Survey, pp. 352–354.

*Discharge measurements of Silver Creek near Riley, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 14 | M. L. Lewis | 54 | 135 | 1.33 | 8.20 | 179 |
| March 15 | do | 64 | 132 | 1.25 | 8.10 | 165 |
| April 6 | do | 48 | 114 | 1.26 | 7.70 | 144 |
| April 16 | do | 45 | 86 | 1.24 | 7.00 | 107 |
| April 23 | do | 40 | 81 | 1.29 | 6.90 | 105 |
| May 23 | do | 32 | 44 | .83 | 5.65 | 36 |
| July 21 | King and Landes | 4.5 | 1.2 | 1.33 | 4.45 | 1.6 |
| October 13 | M. L. Lewis | 2.0 | .73 | 1.30 | 4.50 | .95 |

*Daily gage height, in feet, of Silver Creek near Riley, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Oct. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 5.4 | 5.9 | 6.9 | 6.8 | 5.2 | 4.75 | 3.75 | |
| 2 | | 5.4 | 6.0 | 7.0 | 6.65 | 5.25 | | 4.2 | |
| 3 | 5.0 | 5.4 | 6.0 | | 6.6 | 5.25 | 4.7 | 4.45 | |
| 4 | 5.0 | 5.4 | 6.0 | 7.1 | 6.55 | | 4.7 | 4.4 | |
| 5 | 5.0 | 5.3 | 6.1 | 7.2 | 6.5 | 5.25 | 4.7 | 4.3 | |
| 6 | 5.0 | | | 7.7 | 6.4 | 5.25 | 4.7 | 4.45 | |
| 7 | 5.0 | 5.0 | 6.8 | 7.8 | | 5.25 | 4.65 | 4.7 | |
| 8 | 5.0 | 5.0 | 6.6 | 7.9 | 6.45 | 5.2 | 4.6 | | |
| 9 | | 5.0 | 7.0 | 7.9 | 6.45 | 5.2 | | | |
| 10 | 5.0 | 5.0 | 7.0 | | 6.4 | 5.2 | | | |
| 11 | 5.0 | 5.0 | 7.5 | 7.5 | 6.4 | | | | |
| 12 | 5.0 | 5.0 | 7.9 | 7.2 | 6.2 | 5.2 | | | |
| 13 | 5.0 | | | 7.1 | 6.0 | 5.1 | | | |
| 14 | 6.7 | 5.0 | 8.2 | 7.0 | | 5.0 | | | |
| 15 | 9.0 | 5.0 | 8.1 | 6.9 | 5.8 | 5.0 | | | |
| 16 | | 5.0 | 8.0 | 6.8 | 5.8 | 5.0 | | | |
| 17 | 6.4 | 5.0 | 8.8 | | 5.8 | 5.0 | | | |
| 18 | 6.3 | 5.0 | 8.9 | 6.7 | 5.8 | | | | |
| 19 | 6.0 | 5.0 | 8.5 | 6.7 | 5.7 | 4.95 | | | |
| 20 | 6.0 | | | 7.0 | 5.7 | 4.95 | | | |
| 21 | 5.8 | 7.8 | 8.1 | 6.9 | | 4.95 | | | |
| 22 | 6.8 | 7.7 | 8.0 | 6.95 | 5.6 | 4.9 | | | |
| 23 | | 7.0 | 7.9 | 6.9 | 5.55 | 4.9 | | | |
| 24 | 8.6 | 7.4 | 7.8 | | 5.5 | 4.9 | | | |
| 25 | 7.7 | 6.4 | 7.5 | 6.8 | 5.45 | | | | 5.1 |
| 26 | 6.4 | 6.0 | 7.5 | 7.0 | 5.45 | 4.9 | | | 5.1 |
| 27 | 6.4 | | | 7.05 | 5.45 | 4.85 | | | 5.1 |
| 28 | 6.0 | 6.2 | 7.4 | 6.9 | | 4.85 | | | 5.1 |
| 29 | 5.8 | | 7.4 | 6.8 | 5.3 | 4.85 | | | 5.1 |
| 30 | | | 6.8 | 6.7 | 5.3 | 4.85 | | | 5.1 |
| 31 | 5.5 | | 6.7 | | 5.3 | | | | 5.1 |

*Station rating table for Silver Creek near Riley, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.20 | 0.0 | 5.40 | 26 | 6.60 | 83 | 7.70 | 145 |
| 4.30 | .2 | 5.50 | 30 | 6.70 | 89 | 7.80 | 151 |
| 4.40 | .6 | 5.60 | 34 | 6.80 | 94 | 7.90 | 157 |
| 4.50 | 1.0 | 5.70 | 38 | 6.90 | 99 | 8.00 | 163 |
| 4.60 | 3 | 5.80 | 42 | 7.00 | 105 | 8.10 | 169 |
| 4.70 | 6 | 5.90 | 47 | 7.10 | 111 | 8.20 | 175 |
| 4.80 | 8 | 6.00 | 52 | 7.20 | 116 | 8.30 | 181 |
| 4.90 | 11 | 6.10 | 57 | 7.30 | 122 | 8.40 | 188 |
| 5.00 | 14 | 6.20 | 62 | 7.40 | 127 | 8.50 | 195 |
| 5.10 | 17 | 6.30 | 67 | 7.50 | 133 | 8.60 | 202 |
| 5.20 | 20 | 6.40 | 73 | 7.60 | 139 | 8.70 | 209 |
| 5.30 | 23 | 6.50 | 78 | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is well defined.

*Estimated monthly discharge of Silver Creek near Riley, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 230 | 14 | 58.8 | 3,616 |
| February | 151 | 14 | 41.9 | 2,327 |
| March | 223 | 47 | 128 | 7,870 |
| April | 157 | 89 | 110 | 6,545 |
| May | 94 | 23 | 51.0 | 3,136 |
| June | 23 | 10 | 15.5 | 922 |
| The period | | | | 24,020 |

NOTE.—Ice conditions not known; open-channel rating table applied to winter months without correction. Discharge interpolated on days when gage was not read. Records fragmentary after July 8, as there was no regular observer. Creek was dry in August, September, and the greater part of July.

## SILVER LAKE BASIN.

### SILVER CREEK NEAR SILVERLAKE, OREG.

Silver Creek rises in the western part of Lake County, Oregon, flows northward to Pauline Lake and Marsh, then turns abruptly to the southeast and enters Silver Lake.

The gaging station was established December 29, 1904. It is located 0.9 mile above the county bridge, 1.6 miles southwest of Silver Lake, Oreg.

The channel is straight for 100 feet above and 75 feet below the cable. Both banks are high, rocky, clean, and not subject to overflow. The bed of the stream is composed of rock and gravel, is free from vegetation, and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire, directly at the gage. The initial point for soundings is 9.2 feet west from the anchor bolt on the east end of the cable.

The gage, which was read during 1905 once each day by Henry Egli, is an inclined staff, set on the right bank. The bench mark is a copper bolt cemented in the solid rock on the east side of the stream, 43 feet downstream from the cable, and 12 feet from the edge of low water; elevation above zero of gage, 8.12 feet.

*Discharge measurements of Silver Creek near Silver Lake, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 21 | I. Landes | 21 | 26 | 0.98 | 1.00 | 25 |
| February 23 | do | 22 | 34 | 1.50 | 1.35 | 51 |
| March 17 | do | 21 | 41 | 1.82 | 1.70 | 74 |
| April 8 | do | 22 | 44 | 2.26 | 1.90 | 100 |
| May 7 | do | 24 | 33 | 1.45 | 1.30 | 48 |
| May 31 | do | 21 | 28 | 1.24 | 1.10 | 34 |
| June 14 [a] | do | 18 | 19 | 1.30 | .99 | 24 |
| August 7 [b] | do | 10 | 9.2 | 2.17 | .79 | 20 |
| October 4 [c] | do | 10 | 8.1 | 1.83 | .74 | 14.8 |
| October 24 [d] | do | 9 | 9.8 | 2.12 | .74 | 21 |
| November 10 | do | 10 | 9.9 | 2.22 | .93 | 22 |
| November 24 | do | 9.5 | 9.2 | 1.59 | .73 | 14.8 |
| December 21 [e] | do | 9.5 | 8.3 | .95 | .60 | 7.9 |

[a] Measurements made about 16 feet above cable; meter on rod.
[b] Measurements made about 40 feet above cable; meter on rod.
[c] Measurements made about 50 feet above cable; meter on rod.
[d] Measurements made about 50 feet above cable; meter on cable.
[e] Ice about 5 inches thick.

*Daily gage height, in feet, of Silver Creek near Silver Lake, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 1.0 | 1.5 | 1.5 | 1.8 | 1.05 | 0.9 | 0.8 | 0.8 | 0.75 | 0.8 | 0.8 |
| 2 | 1.0 | 1.0 | 1.7 | 2.45 | 1.65 | 1.0 | .85 | .85 | .75 | .75 | .75 | .7 |
| 3 | 1.05 | 1.0 | 1.7 | 2.4 | 1.4 | 1.1 | .85 | .8 | .75 | .75 | .75 | .7 |
| 4 | 1.0 | .95 | 1.6 | 2.4 | 1.3 | 1.2 | .85 | .8 | .75 | .75 | .75 | .7 |
| 5 | .95 | .95 | 1.5 | 2.8 | 1.4 | 1.15 | .8 | .8 | .75 | .75 | .75 | .7 |
| 6 | .95 | .95 | 1.85 | 2.5 | 1.3 | 1.1 | .75 | .8 | .75 | .8 | .85 | .75 |
| 7 | 1.0 | .9 | 1.8 | 2.0 | 1.3 | 1.15 | .7 | .8 | .75 | .9 | .95 | .7 |
| 8 | 1.0 | 1.3 | 1.6 | 1.95 | 1.35 | 1.2 | .7 | .8 | .75 | .85 | 1.2 | .75 |
| 9 | 1.0 | 1.2 | 1.4 | 1.7 | 1.65 | 1.1 | .7 | .8 | .75 | .85 | 1.2 | .75 |
| 10 | .95 | 1.1 | 1.45 | 1.75 | 1.35 | 1.05 | .75 | .8 | .75 | .8 | 1.25 | .9 |
| 11 | .95 | 1.0 | 1.6 | 1.6 | 1.4 | 1.05 | .75 | .75 | .75 | .75 | 1.2 | 1.0 |
| 12 | 1.25 | 1.05 | 1.55 | 1.5 | 1.7 | 1.0 | .8 | .8 | .75 | .75 | 1.2 | 1.0 |
| 13 | 1.25 | 1.05 | 1.55 | 1.75 | 1.55 | 1.0 | .8 | .8 | .75 | .75 | 1.15 | 1.05 |
| 14 | 1.5 | 1.0 | 1.5 | 1.5 | 1.4 | 1.0 | .8 | .8 | .75 | .75 | .95 | 1.0 |
| 15 | 1.6 | 1.0 | 1.4 | 1.4 | 1.3 | 1.0 | .8 | .8 | .75 | .75 | 1.05 | 1.0 |
| 16 | 1.5 | 1.0 | 1.55 | 1.4 | 1.25 | 1.0 | .8 | .8 | .75 | .75 | .85 | 1.0 |
| 17 | 1.25 | 1.1 | 1.7 | 1.3 | 1.25 | 1.0 | .8 | .8 | .75 | .8 | .85 | 1.0 |
| 18 | 1.2 | 1.3 | 1.5 | 1.55 | 1.25 | 1.0 | .8 | .8 | .75 | .8 | .8 | 1.0 |
| 19 | 1.1 | 1.05 | 1.5 | 1.5 | 1.2 | .95 | .8 | .8 | .75 | .75 | .8 | .85 |
| 20 | 1.0 | 2.0 | 1.65 | 1.4 | 1.15 | .95 | .8 | .85 | .75 | .75 | .85 | .85 |
| 21 | 1.0 | 2.25 | 1.55 | 1.4 | 1.2 | .95 | .8 | .85 | .75 | .75 | .75 | .8 |
| 22 | 1.0 | 1.4 | 1.6 | 1.5 | 1.15 | .95 | .8 | .8 | .8 | .75 | .75 | .8 |
| 23 | 1.05 | 1.8 | 1.6 | 2.0 | 1.1 | .95 | .8 | .8 | .75 | .75 | .75 | .7 |
| 24 | 1.45 | 1.4 | 1.75 | 1.9 | 1.05 | 1.0 | .8 | .8 | .75 | .75 | .75 | .95 |
| 25 | 1.6 | 1.2 | 1.9 | 1.85 | 1.0 | .95 | .8 | .8 | .75 | .75 | .75 | 1.1 |
| 26 | 1.35 | 1.4 | 2.4 | 2.1 | 1.1 | .95 | .8 | .8 | .75 | .75 | .7 | 1.15 |
| 27 | 1.2 | 1.5 | 2.2 | 1.85 | 1.2 | .9 | .8 | .8 | .85 | .75 | .7 | 1.0 |
| 28 | 1.2 | 1.55 | 1.7 | 1.4 | 1.2 | .9 | .8 | .8 | .8 | .75 | .7 | .9 |
| 29 | 1.1 | ....... | 1.5 | 1.65 | 1.2 | .9 | .8 | .8 | .8 | .75 | .75 | .9 |
| 30 | 1.05 | ....... | 1.4 | 1.5 | 1.15 | .9 | .8 | .8 | .75 | .75 | .75 | .9 |
| 31 | 1.05 | ....... | 1.4 | ....... | 1.1 | ....... | .8 | .8 | ....... | .75 | ....... | 1.15 |

*Station rating table for Silver Creek near Silver Lake, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.75 | 15 | 1.00 | 27 | 1.50 | 62 | 2.00 | 107 |
| 0.80 | 17 | 1.10 | 33 | 1.60 | 70 | 2.10 | 119 |
| 0.85 | 19 | 1.20 | 39 | 1.70 | 78 | 2.20 | 131 |
| 0.90 | 21 | 1.30 | 46 | 1.80 | 87 | 2.30 | 143 |
| 0.95 | 24 | 1.40 | 54 | 1.90 | 97 | 2.40 | 155 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0.7 foot and 2 feet.

*Estimated monthly discharge of Silver Creek near Silver Lake, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 70 | 24 | 36.8 | 2,263 |
| February | 137 | 21 | 43.9 | 2,438 |
| March | 155 | 54 | 73.9 | 4,544 |
| April | 203 | 46 | 89.9 | 5,349 |
| May | 87 | 27 | 47.2 | 2,902 |
| June | 39 | 21 | 27.8 | 1,654 |
| July | 21 | 13 | 16.7 | 1,027 |
| August | 19 | 15 | 17.1 | 1,051 |
| September | 19 | 15 | 15.4 | 916 |
| October | 21 | 15 | 15.7 | 965 |
| November | 42 | 13 | 21.4 | 1,273 |
| December | 36 | 13 | 21.6 | 1,328 |
| The year | 203 | 13 | 35.6 | 25,710 |

NOTE.—Ice is known to form at this station during the winter months, but the observer failed to note the length of time that ice conditions existed during 1905. The open-channel rating table was applied to the winter months without correction.

## BRIDGE CREEK NEAR SILVER LAKE, OREG.

Bridge Creek rises in western Lake County, Oreg., and flows northeastward into Silver Creek near the town of Silver Lake.

The gaging station was established January 21, 1905. It is located at the county bridge 2 miles east of Silver Lake, Oreg.

The channel is straight for 50 feet above and 80 feet below the station. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of sand, is free from vegetation, and is permanent. There is but one channel at all stages. The current is swift.

Discharge measurements are made from the downstream side of the bridge to which the gage is attached. The initial point for soundings is the west end of the bridge, downstream side, and is marked by a 10-penny nail and black paint.

A vertical staff gage, which was read once each day during 1905 by M. S. Henderson and W. D. Robinett, is driven 2 feet into the bed of the stream and spiked to projecting timbers in the center of the bridge on the downstream side. The bench mark is a copper bolt cemented in a large bowlder on the east side of the stream just above the bridge; elevation, 9.73 feet above zero of gage.

*Discharge measurements of Bridge Creek near Silver Lake, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 24 | I. Landes | 7 | 3.2 | 1.23 | 2.05 | 4.0 |
| February 22 | do | 7 | 2.6 | 1.04 | 2.05 | 2.7 |
| March 17[a] | do | 7.5 | 2.8 | 1.00 | 2.00 | 2.8 |
| May 31[b] | do | 22 | 12.4 | 1.12 | 2.72 | 13.9 |
| June 15 | do | 22 | 13.2 | 1.14 | 2.79 | 15.0 |
| November 11 | do | 3 | .7 | 1.14 | 2.05 | .8 |

[a] Measurement made 30 feet below bridge.
[b] Measurement made from bridge.

*Daily gage height, in feet, of Bridge Creek near Silver Lake, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 1.95 | 1.9 | 1.95 | 2.4 | 2.7 | 2.2 | ....... | 2.03 | 2.03 | 2.03 | 2.1 |
| 2 | ....... | 2.0 | 1.9 | 1.95 | 2.45 | 2.7 | 2.2 | ....... | 2.03 | 2.03 | 2.02 | 2.1 |
| 3 | ....... | 2.0 | 1.9 | 2.0 | 2.4 | 2.7 | 2.2 | ....... | 2.02 | 2.04 | 2.03 | 1.9 |
| 4 | ....... | 2.0 | 1.9 | 2.0 | 2.4 | 2.7 | 2.15 | ....... | 2.02 | 2.05 | 2.03 | 1.9 |
| 5 | ....... | 1.95 | 1.95 | 1.8 | 2.4 | 2.7 | 2.1 | ....... | 2.01 | 2.06 | 2.02 | 1.9 |
| 6 | ....... | 1.95 | 1.95 | 1.8 | 2.4 | 2.7 | 2.0 | ....... | 2.02 | 2.06 | 2.03 | 1.9 |
| 7 | ....... | 1.95 | 1.95 | 1.85 | 2.2 | 2.7 | ....... | 1.94 | 2.01 | 2.06 | 2.03 | 2.0 |
| 8 | ....... | 1.9 | 1.95 | 1.85 | 2.1 | 2.7 | ....... | 1.93 | 2.01 | 2.04 | 2.03 | 1.9 |
| 9 | ....... | 2.0 | 1.95 | 1.85 | 2.1 | 2.7 | ....... | 1.94 | 2.01 | 2.04 | 2.03 | 1.9 |
| 10 | ....... | 2.2 | 1.95 | 1.9 | 2.1 | 2.75 | ....... | 1.92 | 2.01 | 2.03 | 2.03 | 2.01 |
| 11 | ....... | 1.95 | 1.95 | 1.9 | 2.15 | 2.75 | ....... | 1.9 | 2.01 | 2.04 | 2.03 | 2.01 |
| 12 | ....... | 2.2 | 1.95 | 1.95 | 2.1 | 2.8 | ....... | 1.9 | 2.01 | 2.03 | 2.03 | 2.01 |
| 13 | ....... | 2.2 | 1.95 | 1.95 | 2.1 | 2.8 | ....... | 1.92 | 2.01 | 2.04 | 2.03 | 2.1 |
| 14 | ....... | 2.2 | 2.0 | 1.95 | 2.1 | 2.8 | ....... | 1.92 | 2.02 | 2.04 | 2.03 | 2.1 |
| 15 | ....... | 2.2 | 2.0 | 2.0 | 2.4 | 2.75 | ....... | 1.9 | 2.02 | 2.03 | 2.02 | 2.1 |
| 16 | ....... | 2.4 | 2.0 | 2.0 | 2.4 | 2.7 | ....... | 1.92 | 2.01 | 2.03 | 2.03 | 2.1 |
| 17 | ....... | 2.4 | 2.0 | 2.0 | 2.65 | 2.7 | ....... | 1.95 | 2.01 | 2.02 | 2.03 | 2.3 |
| 18 | ....... | 2.4 | 2.0 | 2.0 | 2.65 | 2.7 | ....... | 1.98 | 2.01 | 2.02 | 2.03 | 2.3 |
| 19 | ....... | 2.4 | 2.0 | 2.0 | 2.65 | 2.6 | ....... | 1.96 | 2.02 | 2.02 | 2.1 | 2.3 |
| 20 | ....... | ....... | 2.0 | 1.95 | 2.65 | 2.55 | ....... | 1.98 | 2.02 | 2.02 | 2.1 | 2.3 |
| 21 | 2.3 | ....... | 2.0 | 1.95 | 2.65 | 2.5 | ....... | 1.98 | 2.02 | 2.02 | 2.1 | 2.4 |
| 22 | 2.3 | ....... | 2.0 | 1.95 | 2.65 | 2.5 | ....... | 2.00 | 2.01 | 2.01 | 2.1 | 2.4 |
| 23 | 2.15 | ....... | 2.0 | 1.95 | 2.6 | 2.4 | ....... | 1.99 | 2.01 | 2.01 | 2.11 | 2.4 |
| 24 | 2.2 | 2.0 | 2.0 | 1.95 | 2.6 | 2.4 | ....... | 1.98 | 2.02 | 2.02 | 2.11 | 2.5 |
| 25 | 2.1 | 1.95 | 2.0 | 1.95 | 2.55 | 2.35 | ....... | 2.0 | 2.03 | 2.02 | 2.11 | 2.5 |
| 26 | 2.05 | 2.0 | 2.0 | 2.3 | 2.6 | 2.3 | ....... | 2.0 | 2.03 | 2.02 | 2.1 | 2.5 |
| 27 | 2.0 | 1.9 | 2.0 | 2.4 | 2.65 | 2.3 | ....... | 2.04 | 2.03 | 2.01 | 2.1 | 2.6 |
| 28 | 2.1 | 1.9 | 2.0 | 2.3 | 2.65 | 2.25 | ....... | 2.03 | 2.02 | 2.01 | 2.1 | 2.6 |
| 29 | 2.0 | ....... | 1.9 | 2.3 | 2.7 | 2.2 | ....... | 2.03 | 2.03 | 2.02 | 2.09 | 2.6 |
| 30 | 1.95 | ....... | 1.95 | 2.4 | 2.7 | 2.2 | ....... | 2.04 | 2.03 | 2.03 | 2.09 | 2.6 |
| 31 | 1.95 | ....... | 1.95 | ....... | 2.7 | ....... | ....... | 2.04 | ....... | 2.03 | ....... | 2.6 |

NOTE.—Increase in gage heights April 26 to December 31 caused by backwater from a dam. Ice conditions December 17-31.

*Station rating table for Bridge Creek near Silver Lake, Oreg., from January 1 to April 25, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 0.8 | 2.00 | 2.8 | 2.20 | 6.3 | 2.40 | 10.0 |
| 1.90 | 1.2 | 2.10 | 4.5 | 2.30 | 8.1 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge made during 1905.

*Station rating table for Bridge Creek near Silver Lake, Oreg., from April 26 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge | Gage height. | Discharge | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.90 | 0.2 | 2.20 | 3.0 | 2.50 | 8.6 | 2.80 | 15.2 |
| 2.00 | .6 | 2.30 | 4.7 | 2.60 | 10.7 | 3.00 | 20.0 |
| 2.10 | 1.3 | 2.40 | 6.6 | 2.70 | 12.9 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905.

*Estimated monthly discharge of Bridge Creek near Silver Lake, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January 21-31 | 8.1 | 2.0 | 4.55 | 99 |
| February 1-19, 24-28 | 10.0 | 1.2 | 4.33 | 206 |
| March | 2.8 | 1.2 | 2.23 | 137 |
| April | 6.6 | .8 | 2.53 | 151 |
| May | 12.9 | 1.3 | 7.79 | 479 |
| June | 15.2 | 3.0 | 10.6 | 631 |
| July 1-6 | 3.0 | .6 | 2.18 | 26 |
| August 7-31 | .8 | .2 | .46 | 23 |
| September | .7 | .6 | .66 | 39 |
| October | .9 | .6 | .73 | 45 |
| November | 1.5 | .7 | .95 | 57 |
| December [a] | 1.3 | .2 | 1.00 | 61 |
| The period | | | | 1,954 |

[a] Ice conditions December 17-31; discharge estimated, 1.3 second-feet.

## BEAR CREEK NEAR SILVER LAKE, OREG.

Bear Creek rises in western Lake County, Oreg., and flows northeastward into the western side of Pauline Lake and Marsh.

The gaging station was established January 21, 1905. It is located at the county bridge 3 miles northeast of Silver Lake, Oreg.

The channel is straight for 60 feet above and 25 feet below the station. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of sand, is free from vegetation, and is shifting. There is but one channel, broken at high water by the two piers of the bridge. The current is moderate.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is a 10-penny nail and paint mark at the west end of the bridge, upstream side.

The gage, which was read once each day during 1905 by Cliff Smith, is an inclined staff set on the right bank about 6 feet above the bridge. The bench mark is a copper bolt cemented in the solid rock 80 feet upstream from the bridge and 160 feet west of the west end of the bridge; elevation, 27.04 feet above the zero of the gage.

*Discharge measurements of Bear Creek near Silver Lake, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 24 | I. Landes | 7 | 4.6 | 3.14 | 4.15 | 14.4 |
| February 23 [a] | do | 11 | 7.4 | 3.19 | 4.60 | 23.6 |
| March 17 [b] | do | 8 | 5.1 | 2.31 | 4.0 | 11.7 |
| May 31 [c] | do | 27 | 37.0 | 1.36 | 5.48 | 50.0 |
| June 15 | do | 28 | 25.0 | 1.88 | 5.25 | 46.0 |
| August 7 [d] | do | 11 | 8.7 | .72 | 3.90 | 6.3 |
| October 4 | do | 10 | 7.0 | .72 | 3.85 | 5.0 |
| October 24 | do | 10 | 6.1 | 1.05 | 3.92 | 6.4 |
| November 11 | do | 9 | 6.4 | 1.06 | 4.03 | 6.8 |

[a] 500 feet below bridge. [b] 400 feet below bridge. [c] 100 feet above bridge. [d] 300 feet below bridge.

*Daily gage height, in feet, of Bear Creek near Silver Lake, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  | 4.1 | 3.95 | 4.1 | 5.0 | 5.45 | 5.05 | 3.9 | 3.8 | 3.85 | 3.9 | 3.9 |
| 2 |  | 4.1 | 4.35 | 4.0 | 4.95 | 5.4 | 5.0 | 3.9 | 3.8 | 3.85 | 3.9 | 3.9 |
| 3 |  | 4.1 | 4.55 | 3.95 | 4.9 | 5.45 | 4.95 | 3.85 | 3.8 | 3.85 | 3.9 | 3.9 |
| 4 |  | 4.1 | 4.0 | 3.95 | 4.9 | 5.45 | 4.95 | 3.85 | 3.8 | 3.85 | 3.9 | 3.9 |
| 5 |  | 4.1 | 4.0 | 3.95 | 4.9 | 5.35 | 4.9 | 3.8 | 3.8 | 3.85 | 3.6 | 3.9 |
| 6 |  | 4.1 | 3.95 | 4.0 | 4.95 | 5.25 | 4.9 | 3.9 | 3.8 | 3.85 | 3.6 | 3.9 |
| 7 |  | 4.1 | 3.95 | 4.0 | 4.95 | 5.2 | 4.9 | 3.9 | 3.8 | 3.95 | 3.8 | 3.0 |
| 8 |  | 4.1 | 3.95 | 4.0 | 5.05 | 5.4 | 4.85 | 3.9 | 3.8 | 3.95 | 3.95 | 3.9 |
| 9 |  | 4.1 | 3.95 | 4.0 | 5.05 | 5.4 | 4.8 | 3.85 | 3.8 | 3.95 | 4.1 | 3.9 |
| 10 |  | 4.1 | 3.95 | 4.0 | 5.0 | 5.4 | 4.8 | 3.85 | 3.8 | 3.9 | 4.1 | 3.7 |
| 11 |  | 4.1 | 3.95 | 4.0 | 4.95 | 5.45 | 4.8 | 3.8 | 3.8 | 3.9 | 4.1 | 3.65 |
| 12 |  | 4.1 | 3.95 | 4.0 | 5.0 | 5.45 | 4.75 | 3.8 | 3.8 | 3.9 | 4.0 | 3.65 |
| 13 |  | 4.1 | 4.0 | 4.0 | 4.95 | 5.4 | 4.75 | 3.8 | 3.8 | 3.9 | 4.0 | 3.7 |
| 14 |  | 4.1 | 4.0 | 4.85 | 4.95 | 5.35 | 4.8 | 3.8 | 3.8 | 3.9 | 3.9 | 3.85 |
| 15 |  | 4.1 | 3.95 | 4.85 | 5.05 | 5.3 | 4.8 | 3.8 | 3.8 | 3.9 | 3.9 | 3.9 |
| 16 |  | 4.1 | 4.0 | 4.85 | 5.25 | 5.2 | 4.8 | 3.85 | 3.8 | 3.9 | 3.9 | 3.95 |
| 17 |  | 4.55 | 4.0 | 4.85 | 5.05 | 5.05 | 4.8 | 3.85 | 3.8 | 3.9 | 3.9 | 3.95 |
| 18 |  | 4.55 | 4.0 | 4.8 | 5.15 | 5.05 | 4.8 | 3.85 | 3.75 | 3.9 | 3.85 | 3.95 |
| 19 |  | 4.5 | 4.0 | 4.8 | 5.15 | 5.0 | 4.8 | 3.85 | 3.75 | 3.9 | 3.75 | 4.0 |
| 20 |  | 4.85 | 4.0 | 4.8 | 5.1 | 4.95 | 3.9 | 3.8 | 3.75 | 3.9 | 3.7 | 4.0 |
| 21 | 4.2 | 5.0 | 4.0 | 4.8 | 5.0 | 5.35 | 3.9 | 3.8 | 3.75 | 3.9 | 3.7 | 4.1 |
| 22 | 4.2 | 4.8 | 4.0 | 4.8 | 4.95 | 5.35 | 3.9 | 3.8 | 3.75 | 3.9 | 3.6 | 4.1 |
| 23 | 4.2 | 4.6 | 4.05 | 4.75 | 4.9 | 5.3 | 3.9 | 3.8 | 3.75 | 3.9 | 3.65 | 4.0 |
| 24 | 4.4 | 4.4 | 3.95 | 4.8 | 5.0 | 5.3 | 3.9 | 3.8 | 3.75 | 3.9 | 3.7 | 3.6 |
| 25 | 4.4 | 4.4 | 3.95 | 4.95 | 5.1 | 5.25 | 3.9 | 3.8 | 3.75 | 3.9 | 3.7 | 4.0 |
| 26 | 4.2 | 4.0 | 3.95 | 4.9 | 5.2 | 5.2 | 3.9 | 3.8 | 3.75 | 3.9 | 3.85 | 4.6 |
| 27 | 4.2 | 4.1 | 3.95 | 4.9 | 5.4 | 5.2 | 3.9 | 3.8 | 3.75 | 3.9 | 3.85 | 4.6 |
| 28 | 4.1 | 4.0 | 3.95 | 4.95 | 5.4 | 5.3 | 3.9 | 3.8 | 3.75 | 3.9 | 3.9 | 4.2 |
| 29 | 4.1 | ....... | 3.95 | 4.75 | 5.4 | 5.25 | 3.9 | 3.8 | 3.75 | 3.9 | 3.9 | 4.2 |
| 30 | 4.1 | ....... | 3.85 | 5.0 | 5.5 | 5.05 | 3.9 | 3.8 | 3.75 | 3.9 | 3.9 | 4.2 |
| 31 | 4.1 | ....... | 3.75 | ....... | 5.5 | ....... | 3.9 | 3.8 | ....... | 3.9 | ....... | 4.2 |

NOTE.- Increased gage heights April 14 to July 19 caused by back water from dam. Dam removed July 20. Ice conditions last half of December.

## SUMMER LAKE BASIN.

### ANA RIVER NEAR SUMMER LAKE, OREG.

Ana River, which discharges into the north end of Summer Lake, has its source in five large springs of almost constant flow and temperature throughout the year. The river is about 5 miles long.

The gaging station was established March 28, 1905. It is located in the NW. ¼ SE. ¼ sec. 6, T. 30 S., R. 17 E., near Summer Lake, Oreg.

The channel is straight for 50 feet above and below the station. Both banks are clean and do not overflow. The bed of the stream is composed of blue clay and is fairly permanent. There is but one channel at all stages. The current is swift. Gage readings may be affected somewhat by backwater from the lake and a temporary irrigation dam.

Discharge measurements are made from a foot log near the gage. The initial point for soundings is the edge of the water on the right bank of the river, and is marked on the foot log.

A vertical staff gage, on which, during 1905, observations were made at irregular intervals by the hydrographer, is set at the right bank of the river. The bench mark is a 60-penny nail in the base of a large yellow pine a short distance above the gage; elevation above zero of gage, 11.84 feet.

*Discharge measurements of Ana River near Summer Lake, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 28 | I. Landes | 27 | 54 | 2.72 | 3.50 | 148 |
| April 6 | do | 27 | 54 | 2.73 | 3.50 | 149 |
| June 8 | do | 27 | 61 | 2.41 | [a] 3.68 | 148 |

[a] Gage height affected by irrigation dam.

## ALBERT LAKE BASIN.

### CHEWAUCAN RIVER AT PAISLEY, OREG.

Chewaucan River rises in south-central Lake County, Oreg., flows northwest, then northeast, and then southeast, and discharges into the south end of Abert Lake. The changes in course are very abrupt.

The gaging station was established January 4, 1905. It is located one-half mile above Paisley, Oreg.

The channel below the station is straight; above the station it is slightly curved for 75 feet and beyond this point there are rapids. The right bank is low, but it overflows only a little, there being no water beyond the cable except in very unusual floods. The left bank is high, is composed of clean gravel, and does not overflow. The bed of the stream is of gravel, is free from vegetation, and is permanent. There is but one channel at all stages. There is a low dam 250 feet below the cable, but it does not back the water up at the gage.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire, 60 feet below the gage. The initial point for soundings is the zero of the tagged wire, 7.1 feet from the clip to which the wire is attached at the left bank.

The gage, which was read once each day during 1905 by George Reed and Miss Lulu Banister, is a vertical rod attached to a tree on the right bank. The bench mark is a 60-penny spike in a notch in the base of a large cottonwood tree on the right bank, 22.5 feet upstream from the cable; elevation, 7.69 feet above zero of gage.

*Discharge measurements of Chewaucan River at Paisley, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 5[a] | I. Landes | 35 | 64 | .80 | 4.15 | 51 |
| February 26 | do | 34 | 69 | 1.48 | 4.20 | 102 |
| March 22 | do | 36 | 75 | 1.79 | 4.45 | 135 |
| April 5 | do | 37 | 86 | 2.14 | 4.65 | 183 |
| May 11 | do | 39 | 93 | 2.28 | 4.72 | 213 |
| June 4 | do | 40 | 111 | 2.77 | 5.12 | 308 |
| July 4 | do | 32 | 50 | .85 | 3.80 | 42 |
| July 26 | do | 32 | 37 | .61 | 3.57 | 23 |
| September 28 | do | 32 | 47 | .89 | 3.67 | 41 |
| November 3 | do | 32 | 42 | .69 | 3.57 | 29 |
| November 22 | do | 32 | 54 | .78 | 3.72 | 42 |

[a] Slush ice running in river.

*Daily gage height, in feet, of Chewaucan River at Paisley, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 4.3 | 4.2 | 4.4 | 5.0 | 4.8 | 4.0 | 3.5 | 3.4 | 3.6 | 3.5 | 3.6 |
| 2 | ....... | 4.1 | 4.3 | 4.5 | 4.95 | 4.75 | 3.9 | 3.5 | 3.4 | 3.6 | 3.5 | 3.7 |
| 3 | ....... | 4.0 | 4.25 | 4.5 | 4.85 | 4.8 | 3.82 | 3.4 | 3.4 | 3.6 | 3.6 | 3.7 |
| 4 | 4.0 | 4.0 | 4.25 | 4.5 | 4.8 | 5.15 | 3.75 | 3.4 | 3.4 | 3.6 | 3.5 | 3.7 |
| 5 | 4.15 | 4.0 | 4.3 | 4.65 | 4.85 | 5.0 | 3.7 | 3.4 | 3.5 | 3.6 | 3.5 | 3.5 |
| 6 | 4.2 | 3.85 | 4.3 | 4.8 | 4.8 | 4.8 | 3.7 | 3.4 | 3.5 | 3.6 | 3.6 | 3.6 |
| 7 | 4.2 | 3.6 | 4.35 | 4.9 | 4.8 | 4.7 | 3.7 | 3.4 | 3.5 | 3.7 | 3.6 | 3.6 |
| 8 | 4.1 | 3.8 | 4.3 | 4.9 | 4.9 | 4.8 | 3.7 | 3.4 | 3.5 | 3.7 | 3.6 | 3.8 |
| 9 | 4.1 | 3.6 | 4.3 | 4.9 | 4.85 | 4.8 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.0 |
| 10 | 5.0 | 3.6 | 4.35 | 4.8 | 4.7 | 4.7 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.2 |
| 11 | 5.15 | 3.5 | 4.4 | 4.75 | 4.7 | 4.6 | 3.6 | 3.4 | 3.5 | 3.6 | 3.5 | 4.1 |
| 12 | 5.2 | 4.1 | 4.5 | 4.8 | 4.8 | 4.7 | 3.6 | 3.4 | 3.5 | 3.6 | 3.5 | 4.1 |
| 13 | 4.9 | 4.2 | 4.65 | 4.9 | 4.75 | 4.6 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.0 |
| 14 | 5.2 | 4.0 | 4.6 | 4.7 | 4.75 | 4.6 | 3.6 | 3.4 | 3.5 | 3.6 | 3.7 | 4.0 |
| 15 | 4.5 | 4.05 | 4.5 | 4.8 | 4.85 | 4.5 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.0 |
| 16 | 4.4 | 3.9 | 4.6 | 4.8 | 4.95 | 4.5 | 3.6 | 3.4 | 3.5 | 3.6 | 3.7 | 3.9 |
| 17 | 4.3 | 3.9 | 4.65 | 4.7 | 5.05 | 4.4 | 3.6 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 |
| 18 | 4.1 | 3.9 | 4.6 | 4.75 | 5.0 | 4.3 | 3.6 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 |
| 19 | 4.05 | 4.05 | 4.6 | 4.7 | 5.0 | 4.3 | 3.6 | 3.4 | 3.5 | 3.5 | 3.7 | 3.7 |
| 20 | 4.0 | 4.25 | 4.5 | 4.7 | 4.95 | 4.3 | 3.7 | 3.4 | 3.5 | 3.5 | 3.6 | 3.8 |
| 21 | 3.95 | 4.1 | 4.55 | 4.75 | 4.85 | 4.2 | 3.7 | 3.4 | 3.5 | 3.5 | 3.6 | 4.2 |
| 22 | 3.9 | 3.95 | 4.45 | 4.8 | 4.85 | 4.2 | 3.7 | 3.4 | 3.5 | 3.5 | 3.6 | 4.5 |
| 23 | 4.5 | 4.0 | 4.45 | 4.9 | 4.85 | 4.2 | 3.6 | 3.4 | 3.5 | 3.5 | 3.7 | 4.6 |
| 24 | 4.4 | 4.1 | 4.4 | 5.0 | 4.8 | 4.2 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.8 |
| 25 | 4.2 | 4.1 | 4.35 | 5.05 | 4.7 | 4.2 | 3.6 | 3.4 | 3.5 | 3.6 | 3.6 | 4.6 |
| 26 | 4.0 | 4.1 | 4.8 | 5.15 | 4.9 | 4.2 | 3.7 | 3.4 | 3.5 | 3.6 | 3.7 | 4.0 |
| 27 | 4.2 | 4.1 | 4.45 | 5.1 | 5.0 | 4.1 | 3.6 | 3.4 | 3.6 | 3.6 | 3.6 | 4.0 |
| 28 | 3.9 | 4.15 | 4.4 | 5.1 | 4.9 | 4.0 | 3.6 | 3.5 | 3.7 | 3.6 | 3.7 | 4.0 |
| 29 | 4.0 | ....... | 4.3 | 5.1 | 4.8 | 4.0 | 3.6 | 3.5 | 3.6 | 3.6 | 3.6 | 4.0 |
| 30 | 4.1 | ....... | 4.0 | 5.15 | 4.8 | 3.9 | 3.5 | 3.4 | 3.6 | 3.6 | 3.6 | 4.0 |
| 31 | 4.5 | ....... | 4.15 | ....... | 4.8 | ....... | 3.5 | 3.4 | ....... | 3.6 | ....... | 4.1 |

NOTE.—Ice gorge January 10–13.

*Station rating table for Chewaucan River at Paisley, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| | | 3.80 | 43 | 4.30 | 111 | 4.80 | 223 |
| 3.40 | 19 | 3.90 | 53 | 4.40 | 131 | 4.90 | 249 |
| 3.50 | 23 | 4.00 | 64 | 4.50 | 152 | 5.00 | 276 |
| 3.60 | 29 | 4.10 | 77 | 4.60 | 174 | 5.10 | 304 |
| 3.70 | 36 | 4.20 | 93 | 4.70 | 198 | | |

NOTE.—The above table is applicable only for open channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined between gage heights 3.55 feet and 5.25 feet.

*Estimated monthly discharge of Chewaucan River at Paisley, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 332 | 53 | 94.1 | 5,786 |
| February | 111 | 23 | 64.6 | 3,588 |
| March | 223 | 64 | 136 | 8,362 |
| April | 318 | 131 | 230 | 13,690 |
| May | 290 | 198 | 238 | 14,630 |
| June | 318 | 53 | 154 | 9,164 |
| July | 64 | 23 | 33.2 | 2,041 |
| August | 23 | 19 | 19.5 | 1,199 |
| September | 36 | 19 | 23.5 | 1,398 |
| October | 36 | 23 | 28.5 | 1,752 |
| November | 36 | 23 | 29.7 | 1,767 |
| December | 223 | 23 | 70.8 | 4,353 |
| The year | 332 | 19 | 93.5 | 67,730 |

NOTE.—Ice gorge January 10-31; discharge assumed 77 second-feet. Ice conditions for the remainder of the winter months not known; open-channel rating table applied.

## MISCELLANEOUS MEASUREMENTS IN GREAT BASIN.

The following miscellaneous measurements were made in the Great Basin in 1905 by W. G. Swendsen, H. S. Kleinschmidt, W. P. Hardesty, A. B. Larson, and I. Landes:

*Miscellaneous measurements in Great Basin, 1905.*

| Date. | Steam. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 21 | Logan River | Logan, Hyde Park and Smithfield Canal, near Logan, Utah. | 10 | 5.6 | 0.83 | 3.85 | 4.7 |
| March 8 | Jordan River | Near Lehi, Utah | 49 | 20 | .83 | .50 | 17 |
| January 28 | Hobble Creek | Springville, Utah, near mouth of creek. | 23 | 13.6 | 1.40 | | 19 |
| February 15 | do | do | 16 | 9.8 | 1.52 | | 15 |
| March 9 | do | do | 8 | 8.6 | .83 | | 6.5 |
| April 3 | Peteetneet Creek. | At mouth of canyon near Payson, Utah. | 10 | | | | [a]20.6 |
| May 6 | do | do | 10 | | | | [a]11.4 |
| August 31 | do | do | 3.45 | 3.86 | .92 | | 3.55 |
| May 3 | Summit Creek | Near Santaquin, Utah. | 11 | 7.3 | 2.95 | | 21.5 |
| May 12 | do | do | 6 | 3.1 | 4.81 | .55 | 15 |
| June 10 | do | do | 6 | 6.5 | 3.71 | 1.08 | 24 |
| August 31 | do | do | 6 | 4.3 | 1.61 | .72 | 7 |
| July 21 | Silver Creek | At Spencer's, Riley, Oreg. | 4 | 1.33 | 1.13 | | 1.5 |
| January 8 | Ana River | County Bridge, Summerlake, Oreg. | 32 | 107 | 1.40 | | 150 |
| May 11 | George Conn's ditch. | Paisley, Oreg | 7 | 3.5 | 1.93 | | 6.7 |
| July 4 | do | do | 7 | 5.2 | 2.78 | | 14.6 |

[a] Weir measurement.

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1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.
1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.

1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165, 166, 167, 168, 169, 170, and 171.
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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

# REPORT
OF
# PROGRESS OF STREAM MEASUREMENTS
FOR
# THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

PART XIII.—Great Basin and Pacific Ocean Drainages in California, and Colorado River Drainage below Gila River

BY

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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART XIII.

By W. B. CLAPP and J. C. HOYT.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

*Annual appropriation for hydrographic surveys, fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly systematized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention. In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. The "Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi River drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. The Great Basin drainage.
No. 177. The Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

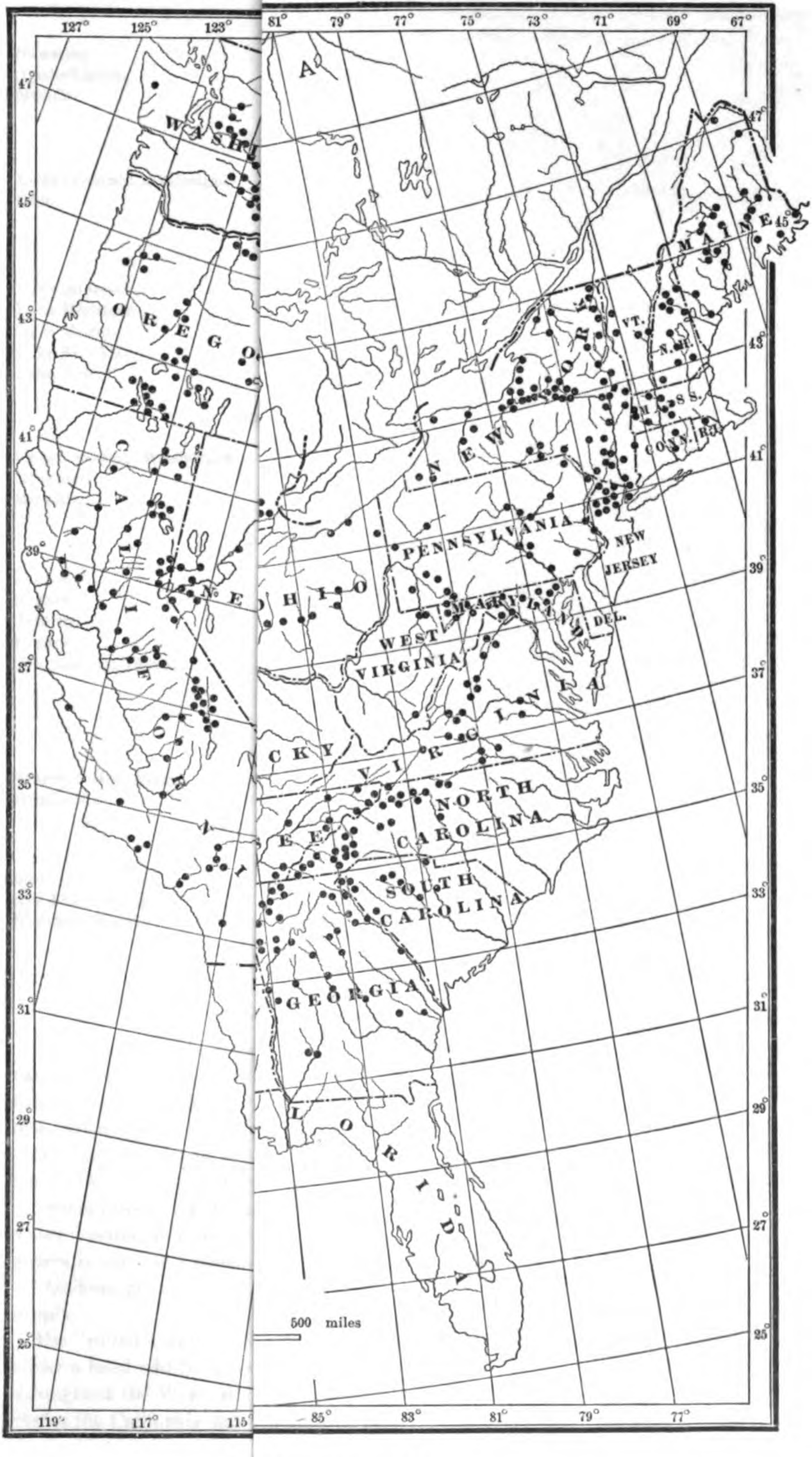
### *List of drainage basins in the United States.*

#### NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor Northern Atlantic.

#### SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor Southern Atlantic.


127°
125°
123°
81°
79°
77°
75°
73°
71°
69°
67°
47°
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39°
37°
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31°
29°
27°
25°
119°
117°
115°
85°
83°
81°
79°
77°
WASH
OREGO
CALIFORNIA
NE
OHIO
CKY
SEE
A
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
NEW YORK
PENNSYLVANIA
NEW JERSEY
MARYLAND
DEL.
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
500 miles

) DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor Eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadalupe.
San Antonio.
Nueces.
Rio Grande.
Minor Western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### THE GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS.

## DEFINITIONS.

The volume of water flowing in a stream, the "run-off" or "discharges," is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the area of cross section, the mean velocity, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this are based the computations for the three remaining columns, which are defined above.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(*a*) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827.

(*b*) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(*c*) When the figure in the place to be rejected is 5 and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(*d*) When the figure in the place to be rejected is 5 and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

*Special rules for computation.*

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.
2. Daily discharges shall be applied directly to the gage heights as they are tabulated.
3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.
4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012; .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.

1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.
1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1.097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$=Net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l\sqrt{h^3}$; $l$=length of weir in inches; $h$=head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1 : 125000, 1 mile=0.50688 inch.
Scale 1 : 90000, 1 mile=0.70400 inch.
Scale 1 : 62500, 1 mile=1.01376 inches.
Scale 1 : 45000, 1 mile=1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief description is given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{R\,s}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$ which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=cbh^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flash-boards or exceptional care in reducing leaking through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings the heads under which they work, and their angular velocities may be accurately abserved.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient be used in the weir formula, and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semi-permanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation it made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates, and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

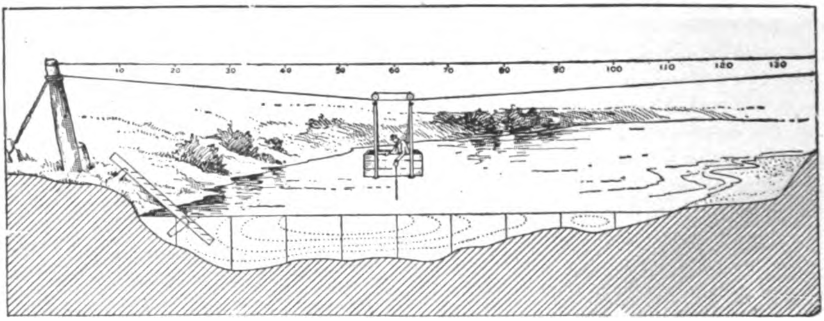

FIG. 1.—Cable station showing section of the river, car, gage, etc.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and conditions of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple point, single point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison, and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. Assuming that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements taken on many streams and under varying conditions show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make freqeunt discharge measurements during the frozen periods by the vertical velocity-curve method, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering in addition to gage heights and discharge, the varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pages 141–148.

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam, the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates; and discharge, mean velocity, and area as abscissas will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the hortzontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex, or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

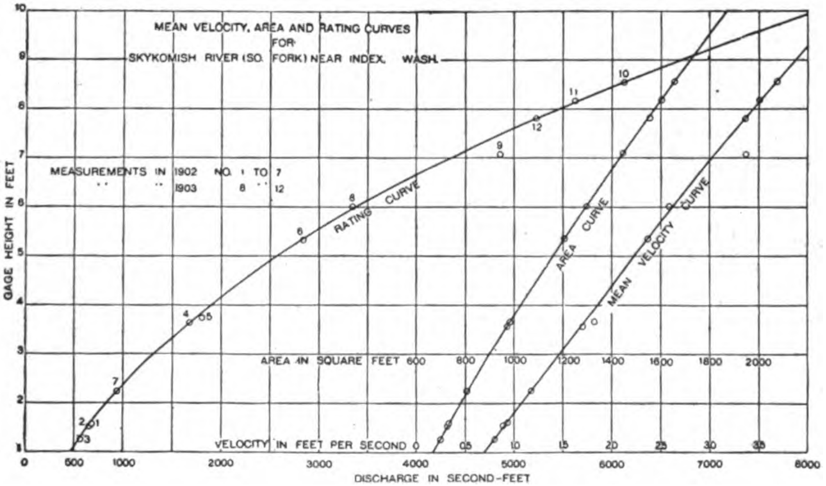

FIG. 2.—Discharge mean-velocity and area curves for South Fork of Skykomish River near Index.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall be either constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly, or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is due to each of these persons, and thanks are extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The hydrographic work of the United States Geological Survey in California is being carried on in cooperation with the State, in accordance with acts of the State legislature approved March 16, 1903, and March 20, 1905.

The act of March 16, 1903, which covered the period from July 1, 1903, to June 30, 1905, is in substance as follows:

> The State board of examiners are hereby empowered to enter into contracts with the Director of the United States Geological Survey for the purpose of making topographic maps to the extent of twenty thousand dollars; also for the purpose of gaging streams, surveying reservoir sites and canal locations, for the conservation and utilization of the flood or storm waters of the State, to the extent of fifteen thousand dollars, [etc.]

The act of March 20, 1905, is in substance the same as previous act, the appropriations being increased to $30,000 for topography and $20,000 for hydrography, and covering the two fiscal years July 1, 1905, to June 30, 1907.

The State board of examiners is composed of the following members: George C. Pardee, governor; C. F. Curry, secretary of state; U. S. Webb, attorney-general.

Although the portions of these bills referring to hydrographic work provide for making surveys of reservoir sites and canal locations, none of the State money has been expended for this purpose. The Geological Survey has made these investigations on Puta Creek, Cache Creek, Sacramento River, Pit River and tributaries, Feather River and tributaries, Owens River, and Colorado River, and has paid the entire expense from its own funds.

The State appropriation of $15,000, which was available between July 1, 1903, and June 30, 1905, was used exclusively for gathering general stream-flow data. The Survey also apportioned $20,000 for the same purpose during the same period. The data being accumulated have a specific value in connection with the future development of the resources of the State. The information will be invaluable in designing and making estimates of cost for storage, irrigation, power and drainage works, and for use in litigation.

The work in California is under the direction of Supervising Engineer J. B. Lippincott,[a] assisted by Engineer W. B. Clapp, who has immediate charge of the accumulation of hydrographic data. Acknowledgments are also due to the following individuals and corporations for assistance rendered and data furnished: To J. C. Pierson, city surveyor of Sacramento, Cal., for river-stage and turbidity records of Sacramento River at Sacramento; to the Kern County Land Company, through A. K. Warren, engineer in charge of water measurements, for the record of Kern River; to the city of Santa Barbara for cooperation in gaging Santa Ynez River; to the Bay Cities Water Company, through Edwin Duryea, jr., chief engineer, for precipitation and run-off data; to the Southern Pacific Company, through its chief engineer, William Hood, for river-stage records of San Joaquin River at Herndon, Cal., and for transportation furnished the supervising engineer and assistants; and to the officials of the Santa Fe Railway for transportation furnished to the supervising engineer and assistants.

The work in the extreme eastern portion of California was carried on under the direction of Henry Thurtell,[b] State engineer of Nevada, assisted by W. A. Wolf, J. T. Shaw, R. A. Craig, O. F. Heizer, and L. A. Wooley. Acknowledgment is due to the Southern Pacific Company for transportation furnished the district hydrographers and assistants.

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## COLORADO RIVER DRAINAGE BASIN BELOW GILA RIVER.

### COLORADO RIVER AT YUMA, ARIZ.

This station is located in the town of Yuma, Ariz., 1½ miles below the mouth of Gila River and 10 miles, by river, above the Mexican boundary. Records of river height have been kept by the Southern Pacific Company since April 1, 1878, on the gage which was established by Arthur Brown, superintendent of the company's bridge and building department, during the summer of 1876.

The channel of the main river is straight for 600 feet above and 5,000 feet below the station. The right bank is low, wooded, and liable to overflow; the left bank is not subject to overflow. The bed of the stream is composed of silt and sand and is very unstable. At low water the channel has a width of 300 feet; at flood stages a large part of the water flows through an old channel and does not pass under the cable. The current is swift and the gaging section regular. At all stages of the river the depth and the velocity are uniform and there are no large eddies.

Prior to May 31, 1903, discharge measurements were made from the railroad bridge. On that date a cable station was established at a point 600 feet below the bridge, and all measurements are now made from a car, except during highest floods, when a boat is used. The cable is supported on masts and is equipped with a winch, by which it can be lowered for the passage of boats. The cable has a span of 650 feet. The initial point for soundings is the cable support on the south or left bank about 20 feet from the water's edge at high water. The water that flows in the old channel at flood stages is measured at the point where it passes under the railway trestle, one-third mile north of the main channel. During the flood of May and June, 1905, there were two breaks in the railroad grade at Araz, Cal., 4 miles from Yuma, and the water passing through these is included in each discharge measurement of the Colorado.

The gage, which was read twice each day during 1905 by W. D. Smith, the resident hydrographer, is in two sections. The lower section of the rod, reading from 15 to 25 feet, is nailed to the pile protection on the south bank of the river 50 feet below the Southern Pacific Railroad bridge. The upper section, reading above 24 feet, is a long pile on the north bank of the river 100 feet above the railway bridge, and is the original gage established in 1876. The bench mark is a standard United States Geological Survey bronze cap located at the railway bridge on the first pier from the south bank; elevation, 35.31 feet above the zero of the gage and 137.4 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water Supply Paper):

Description: Ann 18, iv, pp 298–299; Bull 131, p 51; 140, pp 207–208; WS 16, p 151; 28, p 133; 38, p 324; 50, p 387; 66, p 104; 85, p 17; 100, pp 19–20; 133, pp 25–26.

Discharge: Ann 18, iv, p 299; Bull 131, p 51; 140, p 208; 66, p 104; 85, p 18; 100, pp 20–24; 133, pp 26–29.

Discharge, mean daily: WS 133, p 31.

Discharge, monthly: WS 85, p 20; 100, p 25; 133, p 32.

Evaporation record: WS 133, p 32.

Gage heights: Bull 131, p 52; 140, pp 208–210; WS 11, p 73; 16, p 151; 28, p 141; 38, p 325; 50, p 387; 66, p. 104; 85, p 19; 100, pp 24–25; 133, p 30.

Hydrograph: Ann 12, ii, p 290.

Rating table: WS 85, p 19.

*Discharge measurements of Colorado River at Yuma, Ariz., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 4 | W. D. Smith | 18.60 | 3,985 |
| January 6 | do | 18.95 | 4,573 |
| January 9 | do | 18.65 | 4,170 |
| January 10 | do | 21.10 | 16,090 |
| January 11 | do | 19.20 | 6,401 |
| January 13 | do | 19.25 | 6,348 |
| January 17 | J. S. Evans | 22.30 | 20,420 |
| January 18 | do | 23.95 | 27,450 |
| January 20 | do | 21.00 | 12,170 |
| January 23 | W. D. Smith | 20.20 | 7,863 |
| January 25 | J. S. Evans | 19.80 | 7,055 |
| January 28 | do | 19.55 | 5,727 |
| January 31 | do | 19.30 | 5,278 |
| February 2 | do | 19.60 | 6,054 |
| February 4 | do | 19.70 | 6,632 |
| February 6 | do | 21.40 | 16,600 |
| February 8 | do | 28.00 | 67,730 |
| February 9 | do | 28.75 | 82,820 |
| February 10 | do | 26.20 | 39,580 |
| February 11 | do | 24.10 | 32,120 |
| February 16 | do | 21.50 | 18,610 |
| February 18 | W. D. Smith | 21.40 | 16,490 |
| February 20 | do | 25.10 | 47,000 |
| February 22 | do | 25.80 | 54,730 |
| February 23 | do | 23.70 | 32,990 |
| February 24 | do | 22.05 | 21,990 |
| February 25 | do | 21.50 | 18,860 |
| February 27 | do | 23.45 | 27,730 |
| March 1 | do | 23.95 | 29,070 |
| March 2 | do | 24.90 | 39,260 |
| March 3 | do | 26.70 | 70,170 |
| March 6 | do | 24.80 | 44,310 |
| March 9 | do | 24.10 | 36,400 |
| March 11 | do | 24.20 | 38,625 |
| March 13 | do | 24.45 | 38,870 |
| March 15 | do | 24.00 | 36,720 |
| March 16 | do | 26.10 | 60,640 |
| March 17 | do | 27.35 | 65,820 |
| March 19 | do | 28.00 | 73,440 |
| March 20 | do | 30.25 | 110,800 |
| March 22 | do | 28.90 | 91,200 |
| March 23 | do | 27.75 | 76,930 |
| March 24 | do | 25.60 | 58,600 |
| March 25 | do | 24.10 | 43,050 |
| March 27 | do | 23.10 | 31,020 |
| March 30 | do | 22.00 | 24,390 |
| April 1 | do | 21.50 | 20,690 |
| April 3 | do | 21.30 | 19,480 |
| April 5 | do | 21.60 | 21,000 |
| April 7 | do | 22.50 | 29,840 |
| April 13 | do | 25.30 | 45,800 |
| April 14 | J. N. Johannson | 29.40 | 93,800 |
| April 19 | W. D. Smith | 24.90 | 45,050 |
| April 21 | do | 23.30 | 39,500 |
| April 24 | do | 22.30 | 31,690 |
| April 26 | W. D. Smitn | 23.40 | 37,160 |
| April 27 | A. N. Kelly | 23.95 | 41,630 |
| April 29 | W. D. Smith | 23.95 | 34,990 |
| May 1 | do | 25.00 | 41,520 |
| May 4 | do | 24.25 | 37,280 |
| May 6 | do | 24.55 | 37,410 |
| May 8 | do | 25.10 | 40,050 |
| May 10 | do | 26.10 | 49,200 |
| May 13 | do | 25.40 | 38,840 |
| May 16 | do | 25.00 | 37,320 |
| May 18 | do | 24.70 | 33,910 |
| May 20 | do | 24.30 | 34,580 |
| May 23 | do | 24.90 | 38,390 |
| May 26 | do | 25.80 | 45,300 |
| May 29 | do | 26.80 | 54,810 |
| May 31 | do | 27.40 | 59,020 |
| June 3 | do | 28.00 | 68,160 |
| June 6 | do | 28.45 | 67,600 |
| June 8 | do | 28.30 | 72,930 |
| June 12 | do | 28.25 | 72,590 |
| June 14 | do | 28.70 | 82,020 |
| June 19 | do | 29.15 | 94,320 |
| June 22 | do | 29.10 | 92,400 |
| June 26 | do | 28.55 | 77,610 |
| June 29 | do | 27.60 | 64,370 |
| July 3 | do | 25.90 | 50,640 |
| July 5 | do | 25.45 | 44,950 |
| July 10 | do | 23.35 | 32,980 |
| July 13 | F. R. S. Buttemer | 22.05 | 30,870 |
| July 15 | do | 21.90 | 27,710 |
| July 18 | do | 21.75 | 25,300 |
| July 19 | do | 21.30 | 22,320 |
| July 21 | do | 20.90 | 22,000 |
| July 24 | do | 20.50 | 20,800 |
| July 26 | do | 20.35 | 20,460 |
| July 28 | do | 20.05 | 18,910 |
| July 31 | do | 19.95 | 16,750 |
| August 2 | do | 19.90 | 15,790 |
| August 4 | do | 19.80 | 13,560 |
| August 7 | do | 20.20 | 15,940 |
| August 9 | do | 20.30 | 16,770 |
| August 11 | do | 20.40 | 16,960 |
| August 14 | do | 20.10 | 15,960 |
| August 16 | do | 19.60 | 13,800 |
| August 19 | W. D. Smith | 19.10 | 9,757 |
| August 21 | do | 18.85 | 8,690 |
| August 23 | do | 18.75 | 7,795 |
| August 26 | do | 18.65 | 7,241 |
| August 28 | do | 18.70 | 7,013 |
| August 30 | do | 19.60 | 10,290 |
| September 1 | do | 18.50 | 6,440 |
| September 4 | do | 18.45 | 6,464 |
| September 6 | do | 18.30 | 5,644 |
| September 9 | do | 18.45 | 6,051 |
| September 11 | do | 18.95 | 7,631 |

*Discharge measurements of Colorado River at Yuma, Ariz., in 1905*—Continued.

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| September 13. | W. D. Smith | 18.85 | 7,706 | November 3 | W. D. Smith | 18.50 | 5,812 |
| September 14. | do | 19.40 | 9,667 | November 6 | do | 18.35 | 5,709 |
| September 16. | do | 18.80 | 7,700 | November 9 | do | 18.75 | 6,632 |
| September 18. | do | 18.60 | 6,743 | November 13 | do | 18.75 | 6,308 |
| September 20. | do | 18.70 | 7,131 | November 16 | do | 18.85 | 6,787 |
| September 23. | do | 18.45 | 6,063 | November 23 | do | 18.80 | 6,495 |
| September 26. | do | 18.20 | 5,260 | November 27 | do | 19.00 | 6,652 |
| September 29. | do | 18.00 | 5,287 | November 30 | do | 31.30 | 102,700 |
| October 2 | do | 18.00 | 5,222 | December 1 | do | 28.78 | 77,360 |
| October 4 | do | 18.65 | 7,172 | December 2 | do | 23.50 | 37,160 |
| October 6 | do | 18.80 | 7,295 | December 5 | do | 21.30 | 28,650 |
| October 7 | do | 20.10 | 13,080 | December 8 | do | 19.50 | 16,970 |
| October 10 | do | 20.30 | 14,060 | December 11 | do | 18.75 | 12,620 |
| October 13 | do | 19.70 | 10,660 | December 14 | do | 18.30 | 9,613 |
| October 16 | do | 19.10 | 8,290 | December 16 | do | 18.20 | 8,795 |
| October 19 | do | 18.70 | 6,779 | December 18 | do | 17.95 | 7,807 |
| October 23 | do | 18.60 | 6,025 | December 21 | do | 17.85 | 7,670 |
| October 27 | do | 18.40 | 5,507 | December 26 | do | 17.95 | 7,502 |
| October 31 | do | 18.40 | 5,579 | December 30 | do | 17.80 | 5,981 |

*Daily gage height, in feet, of Colorado River at Yuma, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 18.5 | 19.45 | 23.9 | 21.5 | 25.0 | 27.55 | 26.8 | 19.95 | 18.5 | 18.0 | 18.4 | 28.05 |
| 2 | 18.5 | 19.6 | 25.05 | 21.4 | 24.7 | 27.8 | 26.5 | 19.9 | 18.4 | 18.0 | 18.45 | 24.05 |
| 3 | 18.5 | 19.7 | 26.7 | 21.3 | 24.7 | 28.0 | 25.9 | 19.85 | 18.4 | 18.3 | 18.5 | 23.95 |
| 4 | 18.6 | 19.7 | 26.7 | 21.3 | 24.25 | 28.2 | 25.45 | 19.8 | 18.45 | 18.8 | 18.4 | 22.9 |
| 5 | 18.75 | 20.3 | 25.3 | 21.65 | 24.25 | 28.35 | 25.45 | 19.8 | 18.4 | 19.0 | 18.35 | 21.3 |
| 6 | 18.95 | 21.2 | 24.8 | 22.6 | 24.55 | 28.45 | 25.0 | 19.9 | 18.3 | 18.95 | 18.35 | 20.5 |
| 7 | 19.0 | 21.05 | 24.8 | 22.5 | 24.7 | 28.55 | 24.6 | 20.3 | 18.2 | 20.05 | 18.4 | 20.0 |
| 8 | 18.9 | 27.2 | 24.7 | 22.1 | 25.1 | 28.3 | 24.1 | 20.5 | 18.3 | 20.2 | 18.65 | 19.5 |
| 9 | 18.65 | 28.75 | 24.1 | 22.0 | 25.75 | 28.2 | 23.8 | 20.3 | 18.45 | 20.6 | 18.75 | 19.2 |
| 10 | 21.0 | 26.6 | 23.9 | 22.0 | 26.1 | 28.15 | 23.35 | 20.2 | 18.95 | 20.3 | 18.8 | 18.95 |
| 11 | 19.25 | 24.1 | 24.1 | 21.85 | 26.3 | 28.2 | 22.8 | 20.45 | 18.7 | 20.1 | 18.8 | 18.75 |
| 12 | 19.2 | 22.95 | 24.75 | 22.10 | 26.1 | 28.25 | 22.6 | 20.4 | 18.6 | 19.95 | 19.0 | 18.45 |
| 13 | 19.25 | 22.4 | 24.35 | 25.45 | 25.5 | 28.4 | 22.1 | 20.15 | 18.85 | 19.7 | 18.75 | 18.4 |
| 14 | 19.45 | 22.2 | 23.7 | 29.25 | 25.1 | 28.7 | 22.0 | 20.1 | 19.45 | 19.3 | 18.65 | 18.3 |
| 15 | 19.65 | 22.25 | 24.35 | 29.65 | 25.0 | 28.7 | 21.9 | 19.75 | 19.2 | 19.2 | 18.75 | 18.2 |
| 16 | 19.75 | 21.6 | 26.35 | 27.2 | 25.05 | 28.75 | 21.95 | 19.6 | 18.8 | 19.1 | 18.85 | 18.2 |
| 17 | 22.2 | 21.1 | 27.35 | 24.9 | 24.95 | 28.85 | 22.25 | 19.35 | 18.65 | 18.9 | 18.85 | 18.0 |
| 18 | 23.8 | 21.4 | 26.55 | 24.55 | 24.7 | 28.95 | 21.7 | 19.15 | 18.6 | 18.75 | 18.8 | 17.95 |
| 19 | 22.2 | 22.65 | 28.1 | 24.9 | 24.5 | 29.15 | 21.3 | 19.05 | 18.6 | 18.7 | 18.95 | 17.9 |
| 20 | 21.0 | 24.9 | 30.3 | 24.4 | 24.3 | 29.05 | 21.25 | 19.0 | 18.7 | 18.7 | 18.9 | 17.95 |
| 21 | 20.45 | 25.75 | 29.75 | 23.3 | 24.45 | 29.10 | 20.95 | 18.85 | 18.6 | 18.65 | 18.8 | 17.8 |
| 22 | 20.55 | 25.85 | 28.9 | 22.8 | 24.65 | 29.1 | 20.7 | 18.8 | 18.45 | 18.6 | 18.8 | 17.85 |
| 23 | 20.3 | 23.55 | 27.75 | 22.6 | 24.85 | 29.0 | 20.5 | 18.75 | 18.45 | 18.6 | 18.8 | 17.85 |
| 24 | 20.0 | 22.0 | 25.6 | 22.35 | 25.25 | 28.85 | 20.5 | 18.7 | 18.4 | 18.6 | 18.7 | 17.9 |
| 25 | 19.8 | 21.45 | 24.1 | 22.6 | 25.55 | 28.75 | 20.45 | 18.65 | 18.35 | 18.6 | 18.75 | 17.85 |
| 26 | 19.75 | 23.65 | 23.4 | 23.45 | 25.75 | 28.55 | 20.35 | 18.65 | 18.2 | 18.5 | 18.8 | 17.95 |
| 27 | 19.65 | 23.5 | 23.1 | 23.95 | 26.0 | 28.25 | 20.2 | 18.7 | 18.0 | 18.4 | 19.05 | 17.9 |
| 28 | 18.55 | 23.5 | 22.85 | 24.15 | 26.4 | 27.9 | 20.05 | 18.7 | 18.0 | 18.35 | 21.3 | 17.8 |
| 29 | 19.4 | ....... | 22.4 | 23.95 | 26.8 | 27.6 | 19.95 | 18.65 | 18.0 | 18.4 | 26.2 | 17.8 |
| 30 | 19.35 | ....... | 22.0 | 24.55 | 27.0 | 27.25 | 20.0 | 19.5 | 18.0 | 18.45 | 31.3 | 17.8 |
| 31 | 19.3 | ....... | 21.9 | ....... | 27.4 | ....... | 19.95 | 18.8 | ....... | 18.4 | ....... | 17.8 |

*Daily discharge, in second-feet, of Colorado River at Yuma, Ariz., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3,750 | 5,800 | 29,070 | 20,690 | 41,520 | 61,500 | 57,800 | 16,400 | 6,440 | 5,240 | 5,620 | 77,360 |
| 2 | 3,750 | 6,054 | 39,260 | 20,100 | 39,700 | 65,300 | 55,500 | 15,790 | 6,280 | 5,220 | 5,720 | 37,160 |
| 3 | 3,800 | 6,500 | 70,170 | 19,480 | 39,700 | 68,160 | 50,640 | 14,700 | 6,250 | 6,140 | 5,810 | 40,200 |
| 4 | 3,985 | 6,632 | 70,200 | 19,450 | 37,280 | 67,900 | 45,000 | 13,560 | 6,464 | 7,170 | 5,750 | 35,000 |
| 5 | 4,300 | 9,800 | 51,100 | 21,000 | 37,100 | 67,600 | 44,950 | 12,900 | 6,160 | 8,250 | 5,700 | 28,650 |
| 6 | 4,570 | 16,590 | 44,310 | 30,100 | 37,410 | 67,600 | 42,400 | 14,200 | 5,644 | 7,300 | 5,710 | 23,300 |
| 7 | 4,700 | 9,400 | 44,100 | 29,840 | 38,000 | 69,500 | 40,100 | 15,940 | 5,060 | 13,080 | 5,860 | 20,100 |
| 8 | 4,500 | 62,080 | 43,100 | 25,800 | 40,050 | 72,930 | 37,200 | 17,450 | 5,560 | 13,560 | 6,360 | 16,970 |
| 9 | 4,170 | 82,820 | 36,400 | 24,800 | 46,000 | 70,300 | 35,500 | 16,770 | 6,051 | 15,500 | 6,630 | 15,000 |
| 10 | 16,090 | 52,580 | 34,400 | 24,900 | 49,200 | 69,600 | 32,980 | 16,200 | 8,000 | 14,060 | 6,680 | 13,700 |
| 11 | 6,400 | 37,320 | 38,620 | 23,000 | 52,000 | 71,000 | 32,100 | 16,960 | 7,631 | 12,950 | 6,550 | 12,620 |
| 12 | 6,300 | 29,700 | 42,000 | 26,100 | 48,000 | 72,590 | 31,720 | 16,900 | 6,900 | 12,100 | 6,950 | 10,500 |
| 13 | 6,350 | 22,800 | 38,870 | 45,800 | 38,840 | 76,000 | 30,870 | 16,150 | 7,706 | 10,660 | 6,310 | 10,200 |
| 14 | 7,000 | 21,900 | 32,000 | 93,800 | 37,800 | 82,020 | 29,500 | 15,960 | 9,667 | 9,100 | 6,050 | 9,610 |
| 15 | 8,370 | 22,500 | 36,720 | 97,500 | 37,300 | 82,000 | 27,710 | 14,500 | 8,900 | 8,650 | 6,500 | 9,100 |
| 16 | 8,600 | 18,610 | 60,640 | 70,100 | 37,320 | 83,000 | 28,300 | 13,800 | 7,700 | 8,290 | 6,790 | 8,800 |
| 17 | 20,100 | 14,600 | 65,820 | 45,000 | 37,000 | 86,000 | 31,100 | 11,900 | 7,000 | 7,500 | 6,640 | 8,100 |
| 18 | 27,500 | 16,490 | 62,400 | 43,600 | 33,910 | 88,500 | 25,300 | 10,300 | 6,743 | 6,950 | 6,560 | 7,810 |
| 19 | 19,300 | 31,500 | 73,440 | 45,050 | 34,200 | 94,320 | 22,320 | 9,757 | 6,720 | 6,780 | 6,320 | 7,750 |
| 20 | 12,120 | 47,000 | 110,840 | 43,400 | 34,580 | 91,500 | 22,250 | 9,350 | 7,131 | 6,700 | 6,240 | 7,720 |
| 21 | 9,300 | 54,200 | 103,500 | 39,500 | 35,700 | 92,400 | 22,000 | 8,690 | 6,700 | 6,400 | 6,320 | 7,670 |
| 22 | 10,170 | 54,730 | 91,200 | 35,900 | 37,000 | 92,390 | 21,500 | 8,100 | 6,080 | 6,100 | 6,400 | 7,640 |
| 23 | 7,863 | 32,990 | 76,930 | 33,900 | 38,390 | 89,800 | 20,900 | 7,796 | 6,063 | 6,020 | 6,500 | 7,600 |
| 24 | 7,900 | 21,990 | 58,600 | 31,690 | 41,500 | 84,800 | 20,800 | 7,550 | 5,890 | 6,000 | 6,520 | 7,560 |
| 25 | 7,025 | 18,850 | 43,050 | 33,000 | 43,700 | 82,000 | 20,650 | 7,380 | 5,740 | 5,970 | 6,550 | 7,540 |
| 26 | 6,770 | 30,500 | 34,600 | 37,160 | 45,290 | 77,610 | 20,460 | 7,241 | 5,260 | 5,750 | 6,580 | 7,500 |
| 27 | 6,250 | 27,730 | 31,020 | 41,630 | 47,600 | 73,500 | 19,700 | 7,240 | 5,270 | 5,510 | 6,650 | 7,200 |
| 28 | 5,730 | 25,000 | 29,500 | 39,000 | 51,100 | 68,500 | 18,910 | 7,013 | 5,280 | 5,400 | 24,500 | 6,700 |
| 29 | 5,400 | ....... | 26,900 | 34,990 | 54,810 | 64,370 | 17,200 | 6,850 | 5,287 | 5,540 | 62,500 | 6,400 |
| 30 | 5,070 | ....... | 24,390 | 38,700 | 56,300 | 61,500 | 17,500 | 10,290 | 5,260 | 5,670 | 102,700 | 5,980 |
| 31 | 4,900 | ....... | 23,500 | ....... | 59,020 | ....... | 16,750 | 7,500 | ....... | 5,580 | ........ | 5,900 |

NOTE.—Daily discharge obtained by indirect method.

*Estimated monthly discharge of Colorado River at Yuma, Ariz., for 1905.*

[Drainage area, 225,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 27,500 | 3,750 | 8,130 | 499,900 | 0.036 | 0.042 |
| February | 82,820 | 5,800 | 28,100 | 1,561,000 | .125 | .130 |
| March | 110,800 | 23,500 | 50,540 | 3,108,000 | .225 | .259 |
| April | 97,500 | 19,450 | 37,830 | 2,251,000 | .168 | .187 |
| May | 59,020 | 33,910 | 42,170 | 2,593,000 | .187 | .216 |
| June | 94,320 | 61,500 | 76,470 | 4,550,000 | .340 | .379 |
| July | 57,800 | 16,750 | 30,310 | 1,864,000 | .135 | .156 |
| August | 17,450 | 6,850 | 12,100 | 744,000 | .054 | .062 |
| September | 9,667 | 5,060 | 6,495 | 386,500 | .029 | .032 |
| October | 15,500 | 5,220 | 8,037 | 494,200 | .036 | .042 |
| November | 102,700 | 5,620 | 12,000 | 714,000 | .053 | .059 |
| December | 77,360 | 5,900 | 15,400 | 946,900 | .068 | .078 |
| The year | 110,800 | 3,750 | 27,300 | 19,710,000 | .121 | 1.64 |

*Yearly maximum and minimum gage heights, in feet, of Colorado River at Yuma, Ariz., 1878 to 1905.*

[Compiled from the records of Capt. Isaac Polhamus, the Southern Pacific Railroad, and the United States Geological Survey.]

| Year. | Maximum. | | Minimum. | | Year. | Maximum. | | Minimum. | |
|---|---|---|---|---|---|---|---|---|---|
| | Height. | Date. | Height. | Date. | | Height. | Date. | Height. | Date. |
| 1878....... | 23.0 | June 24 | 14.7 | Dec. 31 | 1892...... | 25.5 | July 3 | 15.5 | Dec. 31 |
| 1879....... | 20.0 | May 12 | 13.2 | Oct. 14 | 1893...... | 25.2 | May 28 | 15.5 | Jan. 2 |
| 1880....... | 24.0 | May 31 | 14.9 | Dec. 8 | 1894...... | 23.7 | June 14 | 15.9 | Jan. 23 |
| 1881....... | 23.5 | June 14 | 15.0 | Jan. 25 | 1895...... | 28.2 | Jan. 20 | 16.8 | Feb. 13 |
| 1882....... | 22.6 | June 18 | 15.5 | Dec. 20 | 1896...... | 24.5 | Sept. 30 | 17.4 | Dec. 17 |
| 1883....... | 24.5 | July 3 | 14.0 | Dec. 14 | 1897...... | 26.1 | June 9 | 17.9 | Dec. 21 |
| 1884....... | [a] 28.5 | June 27 | 14.2 | Dec. 5 | 1898...... | 23.6 | June 27 | 17.5 | Jan. 8 |
| 1885....... | 24.7 | June 13 | 13.7 | Feb. 8 | 1899...... | 27.0 | July 1 | 17.0 | Oct. 17 |
| 1886....... | 26.8 | June 6 | 14.4 | Jan. 19 | 1900...... | 26.0 | June 10 | 16.4 | Sept. 10 |
| 1887....... | 23.5 | June 10 | 14.9 | Jan. 26 | 1901...... | 27.2 | May 31 | 16.2 | Jan. 14 |
| 1888....... | 21.8 | June 25 | 14.8 | Jan. 4 | 1902...... | 24.5 | May 26 | 16.6 | Sept. 28 |
| 1889....... | 22.4 | June 7 | 15.4 | Sept. 27 | 1903...... | 27.7 | June 26 | 16.8 | Jan. 13 |
| 1890....... | 25.5 | June 5 | 16.4 | Jan. 29 | 1904...... | 26.3 | June 5 | 18.3 | Dec. 27 |
| 1891....... | [b] 33.2 | Feb. 26 | 16.4 | Sept. 22 | 1905...... | 31.3 | Nov. 30 | 17.8 | Dec. 31 |

[a] Said to be highest flood for 17 years preceding.

[b] Highest flood recorded.

## COLORADO RIVER BELOW HEADING NO. 3 OF THE IMPERIAL CANAL.

Measurements at this point were begun July 12, 1905, as so much water was at that date going down the canal that it was simpler and more economical to measure the water in the old channel of the Colorado than to continue the measurements on the canal itself.

In the center of the river, opposite heading No. 3, is an island nearly a mile long. The channel on the west side of the island is about 600 feet wide; that on the east side is about 800 feet wide. At first the discharge was measured at a point below the island, but by August 15 a sand bar had formed from the island to the west bank of the river below the heading, and all water passing down on the west of the island entered the canal. August 31 a gage was established above the head of the island, and after that date all discharge measurements were made at the head of the island. Measurements were not made at one certain point, but at any favorable cross section among the shifting bars of mud and quicksand that could be reached and measured by boat or by wading.

The old channel continued to silt up gradually and the new one to scour deeper, and October 20, 1905, all the water was carried by the new channel, i. e., the Imperial canal. The California Development Company made a serious and expensive effort to turn the water back by constructing a dam of piles, brush mats, brush, and sand bags. By the latter part of November this dam had progressed sufficiently to raise the height of the water 2.5 feet, and about 300 second-feet of water flowed down the old channel. Most of the great flood of November 29 at its crest went down the old channel; but by the time it had receded the dam was washed away, the old channel was silted up higher than before, and the new channel was scoured still deeper.

The gage is a vertical rod nailed to the root of a large willow stump on the east bank of the river. It is located at a point nearly opposite the upper end of the upper row of piling, extending from the head of the island obliquely upstream to the west bank, and is opposite station 425 of the Yuma Valley levee line. The bench mark is a nail in a willow tree 20 feet above the gage and 25 feet from the bank; elevation, 13.05 feet above the zero of the gage. Levels from the levee line show the elevation of the zero of the gage to be 109.19 feet above sea level.

*Discharge measurements of Colorado River, below heading No. 3 of Imperial canal in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| July 12 | W. D. Smith | | 11,610 | October 18 | W. D. Smith | 1.50 | 25 |
| July 30 | L. B. Brainard | | 2,484 | October 25 | do | 1.00 | [a]0 |
| August 3 | F. R. S. Buttemer | | 1,999 | October 30 | do | .95 | [a]0 |
| August 10 | do | | 2,218 | November 4 | do | .95 | [a]0 |
| August 18 | W. D. Smith | | 1,169 | November 11 | do | | [a]0 |
| August 24 | do | | 769 | November 18 | do | 2.10 | 87 |
| August 31 | do | 2.90 | 557 | November 25 | do | 2.45 | 205 |
| September 7 | do | 1.80 | 90 | November 30 | J. A. Tolin | | [b]70.000 |
| September 14 | do | 3.80 | 1,232 | December 7 | W. D. Smith | | 878 |
| September 22 | do | 2.10 | 175 | December 13 | do | | [c]0 |
| September 28 | do | 1.60 | 37 | December 17 | do | | [c]0 |
| October 11 | do | 3.50 | 1,014 | December 23 | do | | [a]0 |

[a] No discharge October 20 to November 11. [b] Estimated. [c] No discharge December 13–31.

## CANALS BELOW YUMA, ARIZ.

### COLORADO VALLEY PUMPING AND IRRIGATION COMPANY'S CANAL AT YUMA, ARIZ.

This canal diverts water from the Colorado River at Yuma, Ariz., for the purpose of irrigating land in the upper part of Yuma Valley. The water is raised by a large centrifugal pump operated by a steam engine of 125 horsepower. The lift varies from 2 to 12 feet in ordinary seasons. The expense of pumping is about \$0.60 per acre-foot, not including interest on investment and deterioration of plant. The amount of water used during 1904 was accurately determined by W. D. Smith, and reported in Water-Supply Paper No. 134, page 42, under the head of "Duty of water and seepage investigations." Measurements made in 1903 are reported in Water-Supply Paper No. 100. During 1905 the zanjero used the same "irrigating head" as for the year preceding, his measurements being made by weirs. This was checked by a meter gaging on September 26, which gave a discharge of 34.1 second-feet. The engineer, H. H. Alexander, kept a record of the number of irrigating heads pumped every hour the pump was in operation during 1905. The following table is based on his record. The rainfall data were furnished by S. H. Hackett, of the United States Weather Bureau.

*Monthly duty of water of the Colorado Valley Pumping and Irrigation Company's canal and rainfall at Yuma, Ariz., for 1905.*

| | Duty of water (acre-feet). | | | Rainfall (inches). |
|---|---|---|---|---|
| | Total. | Per acre, gross area. | Per acre, net area. | |
| January | 220 | 0.03 | 0.10 | 1.15 |
| February | 250 | .04 | .11 | 3.43 |
| March | 0 | .00 | .00 | 3.33 |
| April | 1,180 | .18 | .51 | .16 |
| May | 1,470 | .23 | .64 | .00 |
| June | 1,240 | .19 | .54 | .00 |
| July | 1,260 | .19 | .55 | .00 |
| August | 1,550 | .24 | .67 | .02 |
| September | 1,310 | .20 | .57 | .52 |
| October | 530 | .08 | .23 | .02 |
| November | 350 | .05 | .15 | 2.44 |
| December | 300 | .05 | .13 | .32 |
| Total irrigation | 9,660 | 1.48 | 4.20 | 11.39 |
| Total, including rainfall | | | 5.15 | |

Mixed crops: Alfalfa, 1,350 acres; grain, 470 acres; corn and sorghum, 250 acres; miscellaneous, 230 acres. Total net area, 2,300 acres; total gross area, 6,500 acres; number of irrigators, 75. Average annual rainfall at Yuma, 3 inches.

The above includes loss by seepage.

### FARMERS' CANAL NEAR YUMA, ARIZ.

This canal, the property of the Yuma Valley Union Land and Water Company, diverts water from Colorado River at a point 1 mile below Yuma, Ariz., for the purpose of irrigating lands in Yuma Valley.

Measurements have been made at the heading immediately at the river since May, 1903, by means of a boat and cable or by wading. As the point of gaging is above the controlling head gate, gage heights would be of no value for the purpose of constructing rating tables and no gage has been established. The height at any date may be obtained approximately by subtracting 1 foot from the gage reading at Yuma.

The canal is heavily silted, and during 1905 has been dry much of the time.

Results of measurements made in previous years are contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Farmers' Canal near Yuma, Ariz., for 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|
| | | *Sq. feet.* | *Ft. per sec.* | *Sec.-ft.* |
| January 13 | W. D. Smith | 31 | 0.71 | 22 |
| March 7 | do | 31 | .58 | 18 |
| May 11 | do | 67 | 1.91 | 128 |
| June 30 | do | 37 | 2.27 | 84 |

### LUDY CANAL NEAR YUMA, ARIZ.

This canal is the property of the Irrigation Land and Improvement Company. It diverts water from Colorado River at a point 3 miles below Yuma, Ariz., for the purpose of irrigating lands in Yuma Valley.

Miscellaneous measurements have been made at the heading since March, 1903. June 6, 1905, a gage was established and a nilometer placed on the canal by W. D. Smith, at the second gate and bridge, which is 1 mile from the river. No water is taken from the cana above this gate. The gage is nailed to the west wall of the flume below the bridge. The bench mark is a nail driven into the top of the west end of an 8 by 8 inch timber at the lower side of the bridge. Its elevation is 15.00 feet above the zero of the gage. The elevation of the top of the floor of the bridge at the southwest corner is 16.10 feet above the zero of the gage. Discharge measurements are made from the lower side of the bridge. The initial point is the east end of the 8 by 8 inch timber referred to above. The canal is straight both above and below the gate. The velocity of the cross section is fairly uniform. The gage height is not affected by any gates farther down the canal.

The canal is badly silted up and is dry much of the time at low water. During the floods of 1905 the banks were overflowed and considerably damaged.

*Discharge measurements of Ludy canal near Yuma, Ariz., for 1905.*

| Date. | Hydrographer. | Area. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 21 | W. D. Smith | 405 | 0.90 | | 365 |
| April 6 | do | 128 | .18 | | 23 |
| May 5 | do | 104 | .64 | | 67 |
| June 6 | do | 174 | 1.97 | | 343 |
| June 17 | do | 799 | 2.42 | 12.60 | 1,932 |
| July 11 | do | 235 | 1.15 | 10.40 | 271 |
| July 15 | do | 152 | .19 | 9.30 | 29 |

## IMPERIAL CANAL AT HEADINGS IN UNITED STATES AND MEXICO.

*General statement.*—The original heading of the Imperial canal, designated in the following tables as heading No. 1, is located about 10 miles by Colorado River below Yuma, Ariz., on the California side, immediately above the international boundary line and opposite Pilot Knob Mountain. The California Development Company is now constructing a permanent gate on bed rock at a spur of this mountain in place of the wooden one now in use. During the summer of 1904 a second heading was made immediately below the boundary line, and in October of the same year an opening was made to the river at a point 4 miles below the boundary. This last opening is designated as heading No. 3. No gage was placed at either heading No. 2 or No. 3. The canal runs parallel to the river for the first 4 miles of its course, so that it was necessary to cut a channel only one-half mile long.

The first 12 miles of the canal was constructed; the remaining 40 miles is an old natural channel, called Alamo River. The whole length of the canal lies in the Colorado River delta, which is composed of loose, sandy soil, covered with a heavy growth of mesquite, willow, and arrowwood. The canal as a whole had a greater fall per mile than the river, but for the first 15 miles the fall was less than that in the river, and for this reason the canal had to be dredged constantly to keep it open. The exceptional floods of January, February, March, and April, 1905, scoured it out to a channel of considerable depth, and during the regular annual flood of May and June, which was unusually high and long, this scouring was continued to such an extent that when the flood began to recede and the river again began to deposit mud, the velocity in the canal was much greater than in the river below heading No. 3. The result was that the old river channel silted up heavily while the new channel, the canal from heading No. 3 down, was still scouring. As the old river channel filled with silt a greater proportion of the water went down the canal, increasing the velocity; and as the canal scoured deeper the amount and velocity of the water going down the old channel were decreased. These reactions were so great that the process of scouring a new channel, which had been going on slowly for several months, began to make rapid progress. The canal was widened in a few days from 100 to 300 or 400 feet. June 30 the total discharge of the river was 61,500 second-feet, 22 per cent of which went down the canal; July 8 the total discharge was 37,200 second-feet, 67 per cent of which went down the canal. All efforts to stop the flood proved ineffectual.

Meter measurements have been made weekly during the year to determine the total amount of water diverted by the canal, the amount diverted in the United States, the amount diverted in Mexico, and the amount going down the old river channel.

Besides miscellaneous gagings farther down the canal, measurements were made at five points, as follows: Heading No. 1, heading No. 2, heading No. 3 above its junction with the original canal (giving discharge of heading No. 3 alone), heading No. 3 below the junction (giving the total discharge of the canal), and the old channel of the Colorado below heading No. 3. At all of these stations except the last the conditions are constantly changing. The banks are washing away or being filled in, and the bed is silting up or scouring out and being dredged out. For these reasons it has been necessary to put in new gages often. The frequent passage of barges and dredges has rendered the maintenance of permanent cables impracticable, and a light cable has been stretched for each gaging. Measurements each week have been made at such points as would give the desired results, directly or indirectly, with the least expenditure of time and money.

The total discharge of the canal during 1905 was obtained as follows: From January 1 to March 10 by direct meter measurements at heading No. 3 below the junction; from March 11 to June 30 by adding discharges of headings Nos. 1, 2, and 3; from July 1 to December 31 by subtracting the discharge of the old channel below heading No. 3 from the discharge of Colorado River at Yuma. To obtain the discharge of the old channel below heading No. 3 on the dates when it was not measured directly, the total discharge of the canal was subtracted from the discharge of the Colorado at Yuma.

The mean discharge of heading No. 1 for each month was obtained by averaging results of meter measurements. The mean discharge of the whole canal for each month was obtained in the same way. Measurements for the first ten months are so well distributed that they are given equal weight. On account of the flood of November 29, the estimate for November and December is based on an interpolation of the percentage of the total flow of the river diverted by the canal. As the flood in the old channel lasted only five days, any error from this method of calculation is not great.

The monthly summary of the discharge of headings Nos. 2 and 3, showing total diversion made in Mexico, is obtained by subtracting the discharge of heading No. 1 from the total. The monthly summary of the discharge of the old channel below heading No. 3 is obtained by subtracting the total discharge of the canal from the discharge of Colorado River at Yuma.

No gage observer was obtainable for the three lower stations, but gage-height records were kept at headings Nos. 1 and 2.

June 15, 1904, a waste gage was put in operation at a point 12 miles below heading No. 1, called the Quail River waste gate. Water going through this gate passes through Quail River into Padrones River and thence into Volcano Lake. Volcano Lake has two outlets—New River, which discharges into Salton Basin, and Hardy River, which discharges into the Gulf of California through the old channel of the Colorado. March 20, 1905, the flood silted up the channel leading from the waste gate and no more water has been diverted from the canal at this point.

After the flood of November 29, 1905, a channel was dredged from the canal to Quail River from a point 15 miles below heading No. 1, and a considerable amount of water diverted to Padrones River and Volcano Lake. All the water going down the canal past this point discharges through Alamo and New rivers into Salton Basin, except what is lost by seepage and used for irrigation in the Imperial Valley.

The results of the discharge measurements made at the two waste channels mentioned above will be found in the list of miscellaneous discharge measurements.

*Heading No. 1.*—This station was established October 24, 1903. It is located half a mile from the river, 600 feet below the wooden head gates, and is 10 miles by river below Yuma, Ariz., on the California side.

The channel is straight for 600 feet above and 300 feet below the cable and has a width of 70 feet. The right bank is low and is liable to overflow; the left bank has an elevation of 6 feet above high water. The bed of the canal is composed of silt and sand, is free from vegetation, and is very unstable. There is but one channel at all stages, but when the gage at Yuma reads about 26 feet the river overflows into the channel below the gaging section. The current has a moderate velocity.

Discharge measurements are made by means of a boat and cable. The initial point for soundings is a charred post at the southeast corner of the corral about 150 feet west of the right bank.

A vertical gage, which is read twice each day by J. S. Carter, is located just above the international boundary line, on the right bank. The gage is referred to bench marks as follows: (1) A standard United States Geological Survey iron bench-mark post, located near monument 207 of the United States and Mexico boundary line, on a hill about half a mile west of the gaging station; elevation, 52.41 feet above the zero of the gage and 155 feet above sea level. (2) A nail in a tree on the right bank; elevation, 15.20 feet above the zero of the gage. (3) A nail in a post near the ground on the right bank near the corral; elevation, 14.90 feet above the zero of the gage.

The canal at this heading is filled with mud and has been temporarily abandoned, but some flood water passed through it during 1905 and was carefully measured.

*Heading No. 2.*—This heading diverts water from Colorado River at a point in Mexico 50 feet below the international boundary line, 400 feet below heading No. 1, and 10 miles by river from Yuma, Ariz. The station was established January 12, 1905, and weekly discharge measurements were made until August 31, 1905.

The channel is straight for 200 feet above and 600 feet below the cable and is about 80 feet wide. The bed and banks are composed of clay and silt and are unstable. There is but one channel at all stages, but when the gage in Yuma reads about 28 feet the river overflows into the canal below the gaging section. As the canal from heading No. 1 joins this canal about 800 feet below the gage rod, the two gages read about the same.

Discharge measurements are made by means of a boat and cable. The initial point for soundings is a clump of three willow trees growing near the north bank 200 feet below the gage.

A vertical rod gage, which is read daily by A. H. Chance, is driven into the north bank of the canal at a point 50 feet from the river. The bench marks and the elevation of the zero of the gage are the same as for heading No. 1.

*Heading No. 3 (above the junction).*—This heading or intake is in Mexico, 4 miles below the California-Mexico boundary line and 14 miles by Colorado River below Yuma, Ariz. The station was established March 8, 1905. The point of gaging is about one-half mile from the river and 150 feet above the junction of heading No. 3 with the original canal. Gagings at this point give the discharge of heading No. 3 alone.

The channel is straight for 500 feet above the point of gaging and nearly straight for 500 feet below. In the highest floods the banks are overflowed both above and below the station. The cross section is regular, the bed is unstable, and the current is swift. During July, 1905, the flood widened the channel from 100 to 300 feet and lowered the bed about 10 feet.

Discharge measurements are made by means of a boat and cable. The initial point for soundings, a willow stake on the north bank, was washed away by the flood in July, 1905.

The gage and bench marks are the same as for heading No. 3 below the junction, described below. The gage height is an indication of the total discharge of the canal and not of this heading alone.

*Heading No. 3 (below the junction).*—This station was established October 7, 1904. The point of gaging is about one-half mile from the river and 300 feet below the junction of heading No. 3 with the original canal. Gagings at this point give the total discharge of the canal.

The channel is straight for 300 feet above and 500 feet below the cable. The banks are subject to overflow. The cross section is regular. The bed of the canal is composed of silt and sand and is very unstable. During July, 1905, the canal, which at this point was about 100 feet wide, was scoured out to a width of 400 feet and the depth increased about 8 feet.

Discharge measurements are made by means of a boat and cable.

The gage is a vertical rod on the south bank and is referred to bench marks as follows: (1) A nail in the central one of three willow trees 20 feet from the bank and 100 feet above the gage; elevation, 15.83 feet above the zero of the gage. This bench mark was originally 2 feet above the surface of the ground but is now 2 feet below, as soil was deposited here to a depth of about 4 feet by the flood of March 20, 1905. (2) A nail on the north side of a large willow stump 100 feet south of the south bank and 500 feet upstream from the gage; elevation, 22.26 feet above the zero of the gage.

Information in regard to this canal is contained in the following Water-Supply Papers of the United States Geological Survey: 85, p. 77; 100, pp. 27-29; 134, pp. 26-39.

*Discharge measurements made at the Imperial canal headings during 1905.*

| Date. | Heading No. 1. | Heading No. 2. | Heading No. 3. | | Total discharge of canal. |
|---|---|---|---|---|---|
| | | | Above junction. | Below junction. | |
| January 12 | | 380 | | 900 | 900 |
| January 26 | 90 | 350 | | 990 | 990 |
| February 8 | | | | 6,690 | 6,690 |
| February 14 | 460 | 900 | | 2,480 | 2,480 |
| February 28 | | | | 3,100 | 3,100 |
| March 8 | 1,110 | 1,530 | 1,180 | 3,600 | 3,600 |
| March 18 | 1,270 | 2,200 | 1,530 | | 5,000 |
| March 21 | 2,590 | 2,240 | 1,920 | | 6,750 |
| March 28 | 530 | 1,180 | 1,750 | | 3,460 |
| April 6 | 450 | 1,190 | 1,650 | | 3,290 |
| April 20 | 760 | 1,190 | 2,610 | | 4,560 |
| April 27 | 460 | 1,100 | | | |
| May 3 | 180 | 1,470 | 3,360 | | 5,010 |
| May 11 | | 1,940 | 4,160 | | 6,100 |
| May 17 | | 1,580 | 3,780 | | 5,360 |
| May 25 | | 1,790 | 3,560 | | 5,350 |
| June 1 | | 2,240 | 4,500 | | 6,740 |
| June 7 | | 2,660 | 5,830 | | 8,490 |
| June 15 | | 2,700 | 6,130 | | 8,830 |
| June 23 | | 3,260 | 6,880 | | 10,140 |
| June 30 | 390 | 3,140 | 10,430 | | 13,960 |
| July 8 | | | | [a]25,000 | [a]25,000 |
| July 20 | | 1,720 | 15,480 | | 17,200 |
| July 25 | | | 11,220 | | |
| August 3 | | 840 | | | |
| August 10 | | 750 | | | |
| August 18 | | 480 | | | |
| August 24 | | 440 | | | |
| August 31 | | 470 | | | |

[a] Estimated.

NOTE.—Figures in first four columns represent measurements; figures in fifth column are derived from the preceding. For discharge of canal July 25 to December 31, see following table.

*Portion of Colorado River diverted by Imperial canal during 1905.*

| Date. | Discharge of Colorado River in second-feet. | | Diversion by Imperial canal. | |
|---|---|---|---|---|
| | At Yuma. | Below heading No. 3. of Imperial canal. | Second-feet. | Per cent. |
| January 12 | 6,300 | 5,400 | 900 | 14 |
| January 26 | 6,770 | 5,780 | 990 | 15 |
| February 8 | 62,080 | 55,390 | 6,690 | 11 |
| February 14 | 21,900 | 19,420 | 2,480 | 11 |
| February 28 | 25,000 | 21,900 | 3,100 | 12 |
| March 8 | 43,100 | 39,500 | 3,600 | 8 |
| March 18 | 62,400 | 57,400 | 5,000 | 8 |
| March 21 | 103,500 | 96,750 | 6,750 | 7 |
| March 28 | 29,500 | 26,040 | 3,460 | 12 |
| April 6 | 30,100 | 26,810 | 3,290 | 11 |
| April 20 | 43,400 | 38,840 | 4,560 | 11 |
| May 3 | 39,700 | 34,690 | 5,010 | 13 |
| May 11 | 52,000 | 45,900 | 6,100 | 12 |
| May 17 | 37,000 | 31,640 | 5,360 | 14 |
| May 25 | 43,700 | 38,350 | 5,350 | 12 |
| June 1 | 61,500 | 54,760 | 6,740 | 11 |
| June 7 | 69,500 | 61,010 | 8,490 | 12 |
| June 15 | 82,000 | 73,170 | 8,830 | 11 |
| June 23 | 89,800 | 79,660 | 10,140 | 11 |
| June 30 | 61,500 | 47,540 | 13,960 | 23 |
| July 8 | 37,200 | 12,200 | [a] 25,000 | 67 |
| July 12 | 31,720 | 11,610 | 20,110 | 63 |
| July 20 | 22,250 | 5,050 | 17,200 | 77 |
| July 25 | 20,650 | [a] 8,150 | [a] 12,500 | 61 |
| July 30 | 17,500 | 2,480 | 15,020 | 86 |
| August 3 | 14,700 | 2,000 | 12,700 | 86 |
| August 10 | 16,200 | 2,220 | 13,980 | 86 |
| August 18 | 10,300 | 1,170 | 9,130 | 89 |
| August 24 | 7,550 | 770 | 6,780 | 90 |
| August 31 | 7,500 | 560 | 6,940 | 93 |
| September 7 | 5,060 | 90 | 4,970 | 98 |
| September 14 | 9,670 | 1,230 | 8,440 | 87 |
| September 22 | 6,080 | 180 | 5,900 | 97 |
| September 28 | 5,280 | 40 | 5,240 | 99 |
| October 11 | 12,950 | 1,010 | 11,940 | 92 |
| October 18 | 6,950 | 25 | 6,925 | 99⅔ |
| October 25 | 5,970 | ............ | 5,970 | 100 |
| October 30 | 5,670 | ............ | 5,670 | 100 |
| November 4 | 5,750 | ............ | 5,750 | 100 |
| November 11 | 6,550 | ............ | 6,550 | 100 |
| November 18 | 6,560 | 90 | 6,470 | 99 |
| November 25 | 6,550 | 200 | 6,350 | 97 |
| November 30 | 102,700 | [a] 70,000 | [a] 32,700 | 32 |
| December 7 | 20,100 | 880 | 19,220 | 96 |
| December 13 | 10,200 | ............ | 10,200 | 100 |
| December 17 | 8,100 | ............ | 8,100 | 100 |
| December 23 | 7,600 | ............ | 7,600 | 100 |
| December 31 | 5,900 | ............ | 5,900 | 100 |

[a] Approximate.

*Estimated monthly discharge of Imperial canal during 1905.*

| Month. | Heading No. 1, including total diversion in United States. | | Headings Nos. 2 and 3, including total diversion in Mexico. | | Total discharge. | |
|---|---|---|---|---|---|---|
| | Second-feet. | Total in acre-feet. | Second-feet. | Total in acre-feet. | Second-feet. | Total in acre-feet. |
| January | 45 | 2,770 | 900 | 55,330 | 945 | 58,100 |
| February | 460 | 25,550 | 3,630 | 201,600 | 4,090 | 227,200 |
| March | 1,370 | 84,240 | 3,330 | 204,800 | 4,700 | 289,000 |
| April | 555 | 33,020 | 3,370 | 200,500 | 3,925 | 233,600 |
| May | 20 | 1,230 | 5,435 | 334,200 | 5,455 | 335,400 |
| June | 200 | 11,900 | 9,430 | 561,100 | 9,630 | 573,000 |
| July | 130 | 7,990 | 17,840 | 1,097,000 | 17,960 | 1,105,600 |
| August | | | 9,905 | 609,000 | 9,905 | 609,000 |
| September | | | 6,140 | 365,400 | 6,140 | 365,400 |
| October | | | 7,625 | 468,800 | 7,625 | 468,800 |
| November | | | 8,400 | 500,000 | [a] 8,400 | [a] 500,000 |
| December | | | 12,200 | 750,000 | [a] 12,200 | [a] 750,000 |
| The year | 232 | 166,700 | 7,350 | 5,348,000 | 7,582 | 5,514,000 |

[a] Approximate.

## IMPERIAL VALLEY CANALS.

In July, 1904, stations were established on all canals entering the Imperial Valley, as follows: Holt canal, Hemlock canal, Alamo channel, Alamitos canal, Main canal, and Boundary canal. These stations are located on United States territory, and each is near the California-Mexico boundary line.

Discharge measurements are made from footbridges constructed at each station.

The gages are vertical 4 by 4 inch timbers substantially embedded in the ground. Automatic water-stage registers, from which the daily gage-height record is compiled, were placed at the first five stations mentioned above. These canals enter the valley east of Calexico, Cal.

In October a canal, known as canal No. 6, or Wisteria canal, was completed, which enters the valley west of Calexico, Cal. A station was established on this canal in November and weekly discharge measurements made. After April 11, 1905, the Holt canal supplied a much larger district than originally, covering territory which had been taking its supply from Alamo channel, near Eastside levee. A new canal, known as New Holt or No. 7, was built to replace the Holt, and a station was established in May. A station was also established on the Tamareck canal in June. The latter canal diverted water from New River to a district on the west side of New River below Imperial, which formerly obtained its supply from Main canal. Gages were established at both of these stations, but no automatic registers were placed on either canal.

The station on Alamo channel was inaccessible after the end of February on account of the flooded condition of the country. Water was not taken from the Alamo for irrigation after March. Discharge measurements were also made at Rockwood, on Alamo River, but no gage heights were kept. They show the amount of water flowing through this channel to Salton Sea.

Measurements were made at Brawley, on New River, for a similar purpose. They were made under such difficulties, however, that they are of little value. Measurements made at Calexico were used to determine the waste into Salton Sea, since the only diversion was through Tamarack canal. A large quantity of water was wasted from Main canal into New River below the gaging station at Calexico; this waste was measured and added to the discharge of New River in making estimate of total discharge of New River into Salton Lake.

A description of these stations, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey, pages 29–39.

*Discharge measurements of Holt canal, near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Dis-charge. | Date. | Hydrographer. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 4 | W. V. Hardy | 1.30 | 19.5 | June 26 | R. R. McCoslin | 1.64 | 50 |
| January 12 | do | 1.41 | 30 | July 3 | do | 0.38 | 6.9 |
| January 19 | do | 1.43 | 28 | July 10 | do | .33 | 6.1 |
| January 26 | do | 1.23 | 19.5 | July 17 | do | .35 | 5.8 |
| February 2 | do | 1.23 | 18.1 | July 24 | do | .36 | 4.8 |
| February 9 | do | 1.07 | 13.5 | July 31 | do | .36 | 4.2 |
| February 17 | do | 1.90 | 40 | August 7 | do | 1.45 | 30 |
| February 24 | do | .93 | 11.1 | August 14 | do | 1.25 | 38 |
| March 13 | R. R. McCoslin | 1.88 | 51 | August 21 | do | ...... | 85 |
| March 20 | do | 2.06 | 64 | August 21 | do | .039 | 5.1 |
| March 27 | do | 2.84 | 118 | August 28 | do | 2.62 | 133 |
| April 3 | do | 2.81 | 131 | September 4 | do | 2.67 | 131 |
| April 10 | do | 1.13 | 21 | October 10 | W. V. Hardy | 3.08 | 169 |
| April 17 | do | 3.70 | 246 | October 17 | do | .25 | 2 |
| April 24 | do | 3.70 | 256 | October 23 | do | 2.65 | 128 |
| May 1 | do | 3.37 | 202 | November 6 | do | 1.40 | 21 |
| May 8 | do | 2.76 | 143 | November 13 | do | 1.51 | 35 |
| May 15 | do | 2.91 | 163 | November 20 | do | 1.33 | 40 |
| May 22 | do | 2.92 | 169 | November 29 | do | 1.31 | 22 |
| May 29 | do | 2.70 | 128 | October 30 | do | 2.55 | 124 |
| June 5 | do | 2.86 | 150 | September 11 | do | 2.88 | 159 |
| June 12 | do | 3.02 | 177 | September 25 | do | 2.75 | 128 |
| June 18 | do | 1.69 | 57 | October 2 | do | 2.80 | 137 |

*Mean daily gage height, in feet, of Holt canal, near Calexico, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | (1.0) | 1.25 | 1.4 | 2.85 | 3.3 | 2.8 | 0.0 | 0.35 | 3.05 | 2.8 | 2.0 | 1.3 |
| 2 | (1.0) | 1.25 | 1.3 | 2.9 | 3.25 | 2.85 | .0 | .35 | 3.0 | 2.8 | 1.7 | 2.6 |
| 3 | (1.2) | 1.25 | (1.45) | 2.8 | 3.3 | 2.8 | .4 | .35 | 2.75 | 2.8 | 1.7 | 2.8 |
| 4 | (1.3) | 1.25 | (1.6) | 2.5 | 3.2 | 2.8 | .35 | .5 | 2.65 | 2.85 | 1.7 | 3.0 |
| 5 | (1.3) | 1.25 | (1.4) | 2.6 | 2.9 | 2.85 | .35 | 1.15 | 2.7 | 2.85 | 1.5 | 3.0 |
| 6 | (1.5) | 1.3 | 1.4 | 3.05 | (2.75) | 2.95 | .35 | 1.46 | 2.9 | 2.95 | 1.4 | 2.95 |
| 7 | (1.5) | 1.15 | 1.55 | (3.3) | (2.75) | 3.0 | .35 | 1.55 | 2.7 | 3.1 | 1.35 | 2.9 |
| 8 | (1.5) | (1.1) | 1.7 | (3.25) | 2.75 | 2.95 | .35 | 1.65 | 2.5 | 3.1 | 1.35 | 2.9 |
| 9 | (1.5) | 1.05 | 1.8 | (3.25) | 2.75 | 3.0 | .35 | 1.65 | 2.75 | 3.15 | 1.35 | 2.85 |
| 10 | (1.5) | 1.05 | 1.65 | 2.15 | 2.75 | 3.05 | .35 | 1.65 | 2.85 | 3.05 | 1.4 | 2.7 |
| 11 | (1.5) | 1.05 | (1.8) | 3.6 | 2.75 | 3.0 | .35 | 1.55 | 2.9 | 3.15 | 1.45 | 2.7 |
| 12 | 1.4 | 1.0 | (1.9) | 3.65 | 2.8 | 2.95 | .35 | 1.35 | 3.0 | 1.25 | 1.5 | ...... |
| 13 | 1.4 | 1.2 | 1.95 | 3.6 | 2.9 | 2.6 | .35 | 1.3 | 3.1 | .25 | 1.55 | ...... |
| 14 | 1.35 | 1.4 | 2.0 | 3.55 | 2.9 | 2.5 | .35 | 1.25 | 3.05 | .25 | 1.7 | ...... |
| 15 | 1.35 | 1.6 | 1.55 | 3.65 | 2.85 | 2.5 | .35 | 1.1 | 3.0 | .25 | 1.1 | ...... |
| 16 | 1.35 | 1.75 | 1.3 | 3.65 | 2.9 | 2.5 | .35 | .95 | 3.1 | .25 | .95 | ...... |
| 17 | 1.35 | 1.8 | 1.5 | 3.7 | 2.85 | 2.5 | .35 | .95 | 3.15 | .25 | .9 | ...... |
| 18 | 1.35 | 1.35 | 1.55 | 3.8 | 2.85 | 1.75 | .35 | .95 | 3.1 | .25 | .9 | ...... |
| 19 | 1.4 | 1.4 | 1.95 | 3.75 | 2.9 | 1.7 | .35 | 1.0 | 2.6 | .25 | .85 | ...... |
| 20 | 1.55 | 1.4 | 1.8 | 3.8 | 2.9 | 1.65 | .35 | 1.0 | 2.3 | 1.2 | 1.05 | ...... |
| 21 | 1.65 | 1.4 | 1.85 | 3.75 | 2.95 | 1.65 | .35 | 1.05 | 2.75 | 1.3 | .95 | ...... |
| 22 | 1.7 | 1.4 | 2.05 | 3.75 | 2.95 | 1.6 | .35 | 1.5 | 2.95 | 1.5 | .9 | ...... |
| 23 | 1.6 | 1.4 | 2.2 | 3.75 | 2.7 | 1.65 | .35 | 1.95 | 2.9 | 2.65 | .95 | ...... |
| 24 | (1.45) | .95 | 2.35 | 3.7 | 2.6 | 1.6 | .35 | 2.0 | 2.8 | 2.65 | 1.0 | ...... |
| 25 | 1.3 | 1.1 | 2.2 | 3.5 | 2.5 | 1.65 | .35 | 2.0 | 2.0 | 2.7 | .95 | ...... |
| 26 | (1.25) | 1.4 | (2.6) | 3.35 | 2.45 | 1.65 | .35 | 2.0 | 1.35 | 2.7 | .95 | ...... |
| 27 | 1.1 | 1.55 | 2.85 | 3.35 | 2.5 | 0 | .35 | 2.0 | 2.25 | 2.7 | 85 | ...... |
| 28 | .95 | 1.5 | 2.8 | 3.35 | 2.55 | 0 | .35 | 2.6 | 2.8 | 2.7 | .8 | ...... |
| 29 | 1.0 | ...... | 2.6 | 3.35 | 2.9 | 0 | .35 | 2.7 | 2.8 | 2.6 | .9 | ...... |
| 30 | (1.1) | ...... | 2.7 | 3.35 | 2.7 | 0 | .35 | 2.75 | 2.8 | 2.4 | 1.25 | ...... |
| 31 | (1.2) | ...... | 2.80 | ...... | 2.65 | ...... | .35 | 2.85 | ...... | 2.3 | ...... | ...... |

**Note.**—Gage heights in parentheses are estimated.

*Estimated monthly discharge of Holt canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum | Minimum | Mean. | |
| January | 40 | 10 | 24.8 | 1,525 |
| February | 35 | 9 | 21.0 | 1,166 |
| March | 123 | 23 | 57.4 | 3,530 |
| April | 260 | 83 | 208 | 12,380 |
| May | 210 | 109 | 152 | 9,346 |
| June | 181 | 0 | [a] 150 | 8,926 |
| July | 7 | 0 | [a] 150 | 9,223 |
| August | 158 | 3 | [a] 150 | 9,223 |
| September | 202 | 35 | 144 | 8,569 |
| October | 196 | 2 | 96.6 | 5,940 |
| November | 71 | 8 | 27.0 | 1,607 |
| The period | | | | 71,430 |

[a] Estimated. Flood water used for irrigation. Beginning with March 6 Holt heading was used to divert water in No. 5 main canal, but its capacity was not sufficient until April 16.

*Estimated monthly discharge of New Holt or No. 7 canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May | | | 18 | 1,107 |
| June | | | 33 | 1,964 |
| July | | | 33 | 2,029 |
| August | | | 33 | 2,029 |
| September | | | 33 | 1,964 |
| October | | | 33 | 2,029 |
| November | | | 33 | 1,964 |
| The period | | | | 13,090 |

NOTE.—The station record is of no value because most of the water used was obtained from flooded basins to the east. The mean discharge for the entire district covered by the canal was estimated in the field at 33 second-feet.

*Discharge measurements of Hemlock canal near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 4 | W. V. Hardy | 0.87 | 2.0 | June 26 | R. R. McCoslin | 1.96 | 21.0 |
| January 12 | do | 0.88 | 2.2 | July 3 | do | 1.23 | 7.2 |
| January 19 | do | 1.41 | 9.5 | July 10 | do | 1.73 | 17.9 |
| January 26 | do | 0.84 | 1.9 | July 17 | do | 1.69 | 15.9 |
| February 2 | do | 1.25 | 7.4 | July 24 | do | 0.75 | 0.8 |
| February 9 | do | 1.64 | 16.4 | July 31 | do | 1.23 | 7.9 |
| February 17 | R. R. McCoslin | 1.59 | 12.5 | August 7 | do | 1.43 | 12.7 |
| February 24 | do | 1.79 | 17.2 | August 14 | do | 1.59 | 17.4 |
| March 13 | do | 1.20 | 8.7 | August 21 | do | 1.23 | 9.8 |
| March 20 | do | 1.45 | 13.2 | August 28 | do | 1.12 | 7.3 |
| March 27 | do | 1.73 | 23.0 | September 4 | W. V. Hardy | 0.97 | 4.4 |
| April 3 | do | 1.85 | 20.0 | September 11 | do | 1.42 | 13.3 |
| April 10 | do | 1.42 | 12.7 | September 25 | do | 0.82 | 2.1 |
| April 17 | do | 2.45 | 36.0 | October 2 | do | 1.11 | 7.3 |
| April 24 | do | 0.70 | 1.6 | October 10 | do | 1.30 | 8.3 |
| May 1 | do | 1.10 | 6.4 | October 17 | do | 1.12 | 8.0 |
| May 8 | do | 2.04 | 20.4 | October 23 | do | 1.20 | 8.4 |
| May 15 | do | 1.94 | 18.6 | October 30 | do | 1.04 | 5.2 |
| May 22 | do | 1.75 | 14.5 | November 6 | do | 0.90 | 4.0 |
| May 29 | do | 1.54 | 12.1 | November 13 | do | 1.00 | 6.4 |
| June 5 | do | 1.81 | 16.9 | November 20 | do | 0.70 | 2.0 |
| June 12 | do | 0.78 | 2.1 | November 29 | do | 0.89 | 3.1 |
| June 18 | do | 1.7 | 13.2 | | | | |

*Mean daily gage height, in feet, of Hemlock canal near Calexico, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 1.0 | 0.9 | (1.8) | 1.1 | 1.55 | 1.6 | 1.2 | 1.15 | 1.0 | 1.1 | 1.0 |
| 2 | .9 | 1.25 | .9 | 1.9 | 1.05 | 1.55 | 1.5 | 1.2 | 1.1 | 1.1 | 1.15 | 1.0 |
| 3 | .95 | 1.3 | .9 | 1.85 | 1.2 | 1.6 | 1.25 | 1.2 | .9 | 1.1 | 1.25 | 2.0 |
| 4 | 1.0 | 1.3 | .9 | 1.8 | 1.35 | 1.7 | 1.2 | 1.3 | .95 | 1.15 | 1.1 | 1.5 |
| 5 | 1.05 | 1.1 | 1.05 | 2.0 | 1.7 | 1.8 | 1.2 | 1.3 | 1.2 | 1.2 | .95 | 1.5 |
| 6 | 1.15 | .8 | 1.25 | (2.0) | 1.95 | 1.9 | 1.2 | 1.4 | 1.35 | 1.3 | .9 | 1.7 |
| 7 | 1.3 | .8 | 1.3 | (1.9) | 2.0 | 1.95 | 1.55 | 1.45 | 1.35 | 1.45 | .9 | 1.65 |
| 8 | 1.4 | 1.0 | 1.3 | (1.6) | 2.1 | 2.05 | 1.75 | 1.4 | 1.35 | 1.45 | .9 | 1.6 |
| 9 | 1.0 | 1.65 | 1.5 | (1.5) | 2.1 | 2.1 | 1.75 | 1.4 | 1.35 | 1.4 | .95 | 1.55 |
| 10 | .75 | 1.65 | 1.25 | (1.4) | 2.1 | 2.15 | 1.75 | 1.4 | 1.4 | 1.35 | 1.0 | 1.6 |
| 11 | .75 | 1.55 | 1.25 | (1.6) | 2.1 | 2.15 | 1.75 | 1.5 | 1.4 | 1.4 | 1.05 | ...... |
| 12 | .75 | 1.35 | 1.3 | (1.7) | 2.1 | .8 | 1.75 | 1.55 | 1.45 | 1.35 | 1.1 | ...... |
| 13 | .75 | 1.1 | 1.2 | 1.9 | 2.1 | .8 | 1.7 | 1.55 | 1.5 | 1.5 | 1.05 | ...... |
| 14 | .75 | 1.15 | 1.05 | 1.8 | 2.1 | .9 | 1.7 | 1.6 | 1.55 | 1.0 | .95 | ...... |
| 15 | .75 | 1.4 | .95 | 2.0 | 1.95 | .9 | 1.7 | 1.4 | 1.55 | 1.15 | .75 | ...... |
| 16 | .75 | 1.8 | .9 | (2.2) | 2.0 | .9 | 1.7 | 1.25 | 1.55 | 1.25 | .8 | ...... |
| 17 | .75 | 1.6 | 1.05 | 2.45 | 1.95 | 1.4 | 1.7 | 1.2 | 1.55 | 1.1 | .8 | ...... |
| 18 | 1.0 | 1.75 | 1.0 | 2.5 | 1.85 | 1.7 | 1.8 | 1.2 | 1.3 | 1.0 | .85 | ...... |
| 19 | 1.4 | 1.75 | 1.05 | 2.2 | 1.85 | 1.65 | 1.85 | 1.2 | .95 | 1.05 | .8 | ...... |
| 20 | 1.55 | 1.65 | 1.45 | 2.45 | 1.8 | 1.6 | 1.45 | 1.2 | 1.0 | 1.1 | .7 | ...... |
| 21 | (1.4) | 1.5 | 1.5 | 2.35 | 1.75 | 1.55 | 1.0 | 1.25 | 1.05 | 1.0 | .8 | ...... |
| 22 | (1.3) | 1.45 | 1.4 | 2.2 | 1.75 | 1.5 | 1.0 | 1.2 | 1.0 | 1.0 | .9 | ...... |
| 23 | (1.2) | 1.55 | 1.25 | (2.0) | 1.7 | 1.5 | 1.0 | 1.2 | 1.0 | 1.2 | .85 | ...... |
| 24 | (1.0) | 1.8 | 1.3 | 1.45 | 1.75 | 1.75 | .75 | 1.2 | .9 | 1.15 | .75 | ...... |
| 25 | (.9) | 1.65 | 1.55 | 1.45 | (1.7) | 1.95 | .75 | 1.2 | .95 | 1.05 | .75 | ...... |
| 26 | .85 | 1.05 | 1.55 | 1.2 | (1.65) | 1.85 | .75 | 1.2 | 1.0 | 1.05 | .75 | ...... |
| 27 | 1.0 | .9 | 1.75 | 1.1 | (1.6) | 1.8 | .75 | 1.2 | 1.0 | 1.1 | .75 | ...... |
| 28 | 1.0 | .9 | 1.55 | 1.1 | (1.55) | 1.8 | 1.05 | 1.1 | .9 | 1.1 | .85 | ...... |
| 29 | .7 | ...... | 1.15 | 1.1 | 1.5 | 1.75 | 1.25 | 1.1 | .95 | 1.2 | .95 | ...... |
| 30 | .6 | ...... | 1.5 | 1.1 | 1.55 | 1.75 | 1.25 | 1.05 | .95 | .9 | 1.3 | ...... |
| 31 | .55 | ...... | 1.9 | ...... | 1.6 | ...... | 1.25 | 1.0 | ...... | .85 | ...... | ...... |

**Note.**—Gage heights in parentheses are estimated.

*Estimated monthly discharge of Hemlock canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 12.0 | 0.4 | 4.3 | 264 |
| February | 17.4 | 2.0 | 10.0 | 555 |
| March | 23.0 | 3.3 | 10.7 | 658 |
| April | 39.0 | 6.6 | 19.3 | 1,149 |
| May | 21.6 | 5.4 | 15.7 | 965 |
| June | 25.2 | 1.8 | 14.1 | 839 |
| July | 18.4 | 0.8 | 10.9 | 670 |
| August | 17.5 | 5.2 | 10.4 | 639 |
| September | 14.0 | 3.3 | 8.1 | 482 |
| October | 12.6 | 2.4 | 7.5 | 461 |
| November | 9.6 | 1.4 | 4.6 | 274 |
| The period | ........ | ........ | ........ | 6,955 |

*Discharge measurements of New River near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 5 | W. V. Hardy | 2.00 | 12 |
| January 13 | do | 3.20 | 82 |
| January 20 | do | 3.30 | 99 |
| January 27 | do | 5.20 | 323 |
| February 3 | do | 4.00 | 126 |
| February 10 | do | 5.70 | 451 |
| February 18 | do | 6.90 | 986 |
| February 23 | R. R. McCoslin | 7.14 | 1,063 |
| March 2 | do | 7.48 | 1,461 |
| March 9 | do | 7.90 | 1,702 |
| March 16 | do | 7.77 | 1,648 |
| March 23 | do | 6.74 | 1,159 |
| March 29 | do | 8.93 | 2,916 |
| April 6 | do | 6.95 | 1,307 |
| April 12 | do | 6.50 | 949 |
| April 18 | do | 6.80 | 1,149 |
| April 25 | do | 8.71 | 3,052 |
| May 2 | do | 8.47 | 2,417 |
| May 9 | do | 8.80 | 2,890 |
| May 16 | do | 9.19 | 3,237 |
| May 23 | R. R. McCoslin | 9.24 | 3,097 |
| May 30 | do | 9.38 | 3,400 |
| June 6 | do | 9.77 | 3,817 |
| June 13 | do | 10.85 | 4,958 |
| June 20 | do | 11.81 | 5,949 |
| June 27 | do | 12.70 | 10,810 |
| July 5 | do | 13.21 | 11,940 |
| July 12 | do | 13.34 | 13,640 |
| July 18 | Hardy and McCoslin | 13.11 | 13,220 |
| July 25 | do | 12.42 | 10,040 |
| August 1 | R. R. McCoslin | 11.38 | 8,221 |
| August 8 | McCosland and Hardy | 10.72 | 6,531 |
| August 15 | do | 10.90 | 6,997 |
| August 22 | do | 10.22 | 5,529 |
| August 29 | M. V. Hardy | 9.42 | 4,308 |
| September 5 | Hardy and McCoslin | 9.31 | 3,830 |
| September 12 | do | 7.52 | 1,892 |

*Discharge measurements of Alamo Channel near Rockwood, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 7 | W. V. Hardy | | 49 |
| January 14 | do | | 205 |
| January 21 | do | | 77 |
| January 28 | do | | 112 |
| February 4 | do | | 151 |
| February 11 | do | | 61 |
| February 20 | do | | 530 |
| February 25 | do | | 94 |
| March 3 | do | 7.48 | 387 |
| March 11 | do | 6.80 | 1,088 |
| March 17 | do | 7.15 | 1,379 |
| March 25 | do | 10.00 | 1,806 |
| March 30 | do | 9.50 | 1,443 |
| April 8 | do | 6.20 | 635 |
| April 13 | do | 6.00 | 692 |
| April 19 | R. R. McCoslin | 6.00 | 772 |
| April 26 | do | (a) | a 632 |
| May 3 | do | | 1,044 |
| May 10 | do | | 1,770 |
| May 17 | R. R. McCoslin | 6.00 | 990 |
| May 24 | W. V. Hardy | 6.37 | 1,562 |
| May 31 | do | 5.92 | 1,692 |
| June 7 | do | 6.28 | 2,110 |
| June 14 | do | 6.85 | 3,644 |
| June 21 | do | | 5,348 |
| June 28 | do | 9.60 | 3,253 |
| July 6 | do | 9.00 | 4,234 |
| July 13 | do | 9.50 | 3,932 |
| July 19 | do | | 3,501 |
| July 26 | do | | 3,104 |
| August 2 | do | 8.80 | 3,551 |
| August 9 | do | 8.60 | 2,815 |
| August 16 | do | 8.50 | 2,874 |
| August 23 | do | 9.80 | 2,439 |
| August 30 | do | 9.93 | 2,509 |
| September 6 | Hardy and McCoslin | 9.95 | 2,115 |
| September 13 | do | 10.45 | 3,500 |

[a] Gage washed out.

***Discharge measurements of Alamitos canal, Calexico, Cal., in 1905.***

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| January 3 | W. V. Hardy | 1.48 | 30 | June 12 | R. R. McCoslin | 1.32 | 37 |
| January 11 | do | 1.54 | 39 | June 18 | W. V. Hardy | 1.30 | 30 |
| January 18 | do | 1.11 | 15.1 | June 26 | R. R. McCoslin | 1.35 | 36 |
| January 26 | do | 1.05 | 12.9 | July 5 | do | 1.33 | 34 |
| February 2 | do | 1.06 | 13.6 | July 10 | do | 1.34 | 33 |
| February 9 | do | 0.52 | 1.0 | July 17 | do | 1.35 | 34 |
| February 17 | R. R. McCoslin | 1.05 | 16.8 | July 24 | do | 1.34 | 33 |
| February 24 | do | 1.00 | 15.7 | July 31 | do | 1.34 | 33 |
| March 1 | do | 0.82 | 9.1 | Aug. 7 | do | 1.12 | 22 |
| March 8 | do | | 0 | August 14 | do | 1.12 | 22 |
| March 15 | do | | 0 | August 21 | do | 1.17 | 24 |
| March 22 | do | | 0 | August 28 | do | 1.27 | 31 |
| March 29 | do | 1.20 | 24 | September 4 | do | 1.34 | 39 |
| April 5 | do | 1.53 | 44 | September 11 | W. V. Hardy | 1.42 | 43 |
| April 11 | do | 1.63 | 50 | September 25 | do | 1.23 | 36 |
| April 17 | do | 1.67 | 57 | October 9 | do | 1.30 | 40 |
| April 24 | do | 1.39 | 40 | October 16 | do | 1.32 | 45 |
| May 1 | do | 1.10 | 26 | October 23 | do | 1.27 | 38 |
| May 8 | do | 1.15 | 28 | November 13 | do | | 0 |
| May 15 | do | 1.41 | 39 | November 18 | do | | 0 |
| May 22 | do | 1.34 | 35 | November 30 | do | 0.42 | 5.4 |
| May 29 | do | 1.37 | 36 | October 30 | do | 0.90 | 18.3 |
| June 5 | do | 1.35 | 36 | November 6 | do | | 0 |

*Mean daily height in feet, of Alamitos canal near Calexico, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 1.2 | 0.8 | 1.35 | 1.1 | 1.35 | 1.3 | 1.05 | 1.4 | 1.1 | 0.45 | 0.2 |
| 2 | 1.5 | 1.1 | .8 | 1.5 | 1.1 | 1.35 | 1.3 | 9 | 1.4 | 1.25 | .45 | .25 |
| 3 | 1.5 | 1.25 | .6 | 1.6 | 1.1 | 1.35 | 1.35 | 1.05 | 1.35 | 1.15 | .2 | .25 |
| 4 | 1.45 | 1.1 | .4 | 1.55 | 1.1 | 1.35 | 1.35 | 1.1 | 1.35 | 1.3 | .1 | .2 |
| 5 | 1.45 | .95 | .35 | 1.5 | 1.1 | 1.35 | 1.35 | 1.1 | 1.3 | 1.3 | .0 | .2 |
| 6 | 1.4 | .95 | .35 | 1.55 | 1.1 | 1.35 | 1.35 | 1.1 | 1.35 | 1.3 | .15 | .2 |
| 7 | 1.45 | .95 | .3 | 1.6 | 1.1 | 1.35 | 1.35 | 1.1 | 1.45 | 1.25 | .25 | .2 |
| 8 | 1.5 | .9 | .1 | 1.6 | 1.15 | 1.35 | 1.35 | 1.1 | 1.45 | 1.25 | .3 | .2 |
| 9 | 1.6 | .7 | .1 | 1.6 | 1.2 | 1.3 | 1.35 | 1.15 | 1.4 | 1.25 | .3 | .2 |
| 10 | 1.6 | .5 | .1 | 1.65 | 1.25 | 1.35 | 1.35 | 1.15 | 1.4 | 1.25 | .3 | .2 |
| 11 | 1.6 | .5 | .1 | 1.65 | 1.3 | 1.3 | 1.35 | 1.15 | 1.4 | 1.25 | .25 | .2 |
| 12 | 1.6 | .5 | .1 | 1.65 | 1.4 | 1.3 | 1.35 | 1.15 | 1.45 | 1.25 | .3 | .25 |
| 13 | 1.6 | .5 | .1 | 1.65 | 1.4 | 1.3 | 1.35 | 1.15 | 1.5 | 1.25 | .3 | ...... |
| 14 | 1.7 | .5 | .1 | 1.65 | 1.4 | 1.35 | 1.35 | 1.1 | 1.45 | 1.3 | .25 | ...... |
| 15 | 1.45 | .55 | .0 | 1.65 | 1.4 | 1.35 | 1.35 | 1.1 | 1.4 | 1.3 | .3 | ...... |
| 16 | 1.5 | .65 | .0 | 1.65 | 1.3 | 1.35 | 1.35 | 1.1 | 1.4 | 1.35 | .3 | ...... |
| 17 | 1.15 | 1.05 | .0 | 1.65 | 1.2 | 1.3 | 1.35 | 1.1 | 1.4 | 1.35 | .25 | ...... |
| 18 | 1.1 | 1.05 | .0 | 1.7 | 1.2 | 1.3 | 1.35 | 1.1 | 1.4 | 1.35 | .2 | ...... |
| 19 | 1.1 | 1.05 | .0 | 1.75 | 1.2 | 1.3 | 1.35 | 1.15 | 1.35 | 1.25 | .2 | ...... |
| 20 | 1.1 | 1.05 | .0 | 1.35 | 1.25 | 1.3 | 1.35 | 1.2 | 1.4 | 1.2 | .2 | ...... |
| 21 | 1.05 | 1.05 | .0 | 1.4 | 1.35 | 1.3 | 1.35 | 1.2 | 1.45 | 1.2 | .15 | ...... |
| 22 | 1.1 | 1.05 | .0 | 1.55 | 1.35 | 1.3 | 1.35 | 1.15 | 1.45 | 1.15 | .15 | ...... |
| 23 | 1.1 | 1.0 | .15 | 1.45 | 1.35 | 1.3 | 1.35 | 1.2 | 1.4 | 1.25 | .15 | ...... |
| 24 | 1.1 | 1.0 | .65 | 1.4 | 1.35 | 1.3 | 1.35 | 1.25 | 1.2 | 1.25 | .2 | ...... |
| 25 | 1.0 | 1.05 | .7 | 1.4 | 1.35 | 1.35 | 1.35 | 1.25 | 1.25 | 1.2 | .25 | ...... |
| 26 | 1.05 | 1.1 | .7 | 1.4 | 1.35 | 1.35 | 1.35 | 1.25 | 1.25 | 1.2 | .25 | ...... |
| 27 | 1.15 | .8 | .85 | 1.4 | 1.35 | 1.35 | 1.35 | 1.3 | 1.2 | 1.15 | .35 | ...... |
| 28 | 1.2 | .75 | .9 | 1.25 | 1.35 | 1.35 | 1.35 | 1.3 | 1.1 | 1.15 | .4 | ...... |
| 29 | 1.2 | ...... | 1.3 | 1.15 | 1.35 | 1.35 | 1.35 | 1.3 | 1.15 | 1.15 | .35 | ...... |
| 30 | 1.2 | ...... | 1.4 | 1.15 | 1.35 | 1.3 | 1.35 | 1.25 | 1.1 | .9 | .25 | ...... |
| 31 | 1.25 | ...... | 1.3 | ...... | 1.35 | ...... | 1.35 | 1.3 | ...... | .8 | ...... | ...... |

*Estimated monthly discharge of Alamitos canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 50 | 11 | 26.6 | 1,636 |
| February | 23 | .5 | 11.4 | 633 |
| March | 36 | 0 | 4.9 | 301 |
| April | 65 | 28 | 45.6 | 2,714 |
| May | 40 | 25 | 31.8 | 1,955 |
| June | 38 | 30 | 34.4 | 2,047 |
| July | 35 | 32 | 33.9 | 2,084 |
| August | 34 | 11 | 23.9 | 1,470 |
| September | 49 | 28 | 40.8 | 2,428 |
| October | 47 | 18 | 35.8 | 2,201 |
| November | 6 | 0 | 2.7 | 161 |
| The period | | | | 17,630 |

*Discharge measurements of Main canal near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec. ft.* | | | *Feet.* | *Sec. ft.* |
| January 3 | W. V. Hardy | 3.90 | 439 | June 12 | R. R. McCoslin | 4.17 | 575 |
| January 11 | do | 4.20 | 524 | June 18 | do | 4.17 | 540 |
| January 18 | do | 4.50 | 567 | June 26 | do | 4.23 | 571 |
| January 26 | do | 4.20 | 510 | July 3 | do | 4.25 | 572 |
| February 2 | do | 4.18 | 507 | July 10 | do | 4.38 | 567 |
| February 15 | do | 4.09 | 485 | July 17 | do | 4.36 | 582 |
| February 17 | R. R. McCoslin | 4.15 | 472 | July 24 | do | 4.32 | 583 |
| February 23 | do | 3.95 | 447 | July 31 | do | 4.23 | 580 |
| March 1 | do | 4.49 | 595 | August 7 | do | 4.29 | 556 |
| March 8 | do | | 0 | August 14 | do | 4.33 | 562 |
| March 15 | do | | 0 | August 21 | do | 4.33 | 540 |
| March 22 | do | 3.52 | 410 | August 28 | do | 4.29 | 536 |
| March 29 | do | 4.79 | 651 | September 4 | do | 4.30 | 558 |
| April 5 | do | 4.84 | 675 | September 11 | W. V. Hardy | | 0 |
| April 11 | do | 4.98 | 729 | September 25 | do | 4.27 | 551 |
| April 17 | do | 5.04 | 735 | October 2 | do | | 0 |
| April 24 | do | 4.91 | 725 | October 9 | do | 4.29 | 559 |
| May 1 | do | 4.47 | 648 | October 16 | do | 4.30 | 546 |
| May 8 | do | 4.42 | 623 | November 3 | do | 2.90 | 298 |
| May 15 | do | 4.34 | 586 | November 6 | do | 3.60 | 380 |
| May 22 | do | 4.24 | 562 | November 13 | do | 3.60 | 380 |
| May 29 | do | 4.32 | 595 | November 18 | do | 3.55 | 378 |
| June 5 | do | 4.19 | 566 | November 30 | do | 3.50 | 376 |

*Mean daily gage height, in feet, of Main canal near Calexico, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.9 | 4.05 | 4.5 | 4.7 | 4.45 | 4.2 | 4.25 | 4.2 | 4.3 | (a) | 2.3 | 3.4 |
| 2 | 3.95 | 4.2 | 4.45 | 4.85 | 4.4 | 4.2 | 4.25 | 4.2 | 4.3 | (a) | 2.9 | 3.45 |
| 3 | 3.9 | 4.25 | 4.05 | 4.95 | 4.4 | 4.2 | 4.25 | 4.2 | 4.3 | (a) | 3.22 | 3.75 |
| 4 | 3.85 | 4.15 | (a) | 4.9 | 4.4 | 4.2 | 4.25 | 4.25 | 4.3 | (a) | 3.55 | 3.5 |
| 5 | 3.85 | 3.95 | (a) | 4.85 | 4.45 | 4.2 | 4.25 | 4.25 | 4.3 | 3.95 | 3.45 | 3.9 |
| 6 | 3.75 | 3.8 | (a) | 4.9 | 4.4 | 4.2 | 4.25 | 4.25 | 4.3 | 4.2 | (3.55) | 3.95 |
| 7 | 3.7 | 3.8 | (a) | 4.95 | 4.4 | 4.2 | 4.3 | 4.3 | (a) | 4.25 | (3.6) | 3.95 |
| 8 | 3.75 | 3.8 | (a) | 4.95 | 4.45 | 4.2 | 4.35 | 4.3 | (a) | 4.2 | (3.6) | 3.95 |
| 9 | 3.95 | 3.85 | (a) | 5.0 | 4.45 | 4.2 | 4.35 | 4.3 | (a) | 4.3 | (3.6) | 3.95 |
| 10 | 4.2 | 3.85 | (a) | 5.0 | 4.4 | 4.2 | 4.35 | 4.3 | (a) | 4.3 | (3.6) | 3.6 |
| 11 | 4.2 | 3.85 | (a) | 5.0 | 4.4 | 4.2 | 4.35 | 4.35 | (a) | 4.3 | 3.6 | ...... |
| 12 | 4.4 | 3.85 | (a) | 5.0 | 4.45 | 4.2 | 4.35 | 4.35 | .5 | 4.3 | 3.6 | ...... |
| 13 | 4.55 | 3.8 | (a) | 5.0 | 4.45 | 4.2 | 4.35 | 4.35 | 2.0 | 4.3 | 3.6 | ...... |
| 14 | 4.4 | 3.95 | (a) | 5.0 | 4.4 | 4.25 | 4.35 | 4.35 | 2.5 | 4.3 | 3.6 | ...... |
| 15 | 4.3 | 4.1 | (a) | 5.05 | 4.35 | 4.2 | 4.35 | 4.35 | 2.95 | 4.3 | (3.6) | ...... |
| 16 | 4.35 | 4.2 | (a) | 5.05 | 4.3 | 4.2 | 4.35 | 4.35 | 3.1 | 4.35 | (3.6) | ...... |
| 17 | 4.4 | 4.1 | (a) | 5.05 | 4.3 | 4.25 | 4.35 | 4.35 | 3.15 | 4.35 | (3.6) | ...... |
| 18 | (4.5) | 4.05 | (a) | 5.1 | 4.3 | 4.2 | 4.35 | 4.35 | 3.15 | 4.35 | 3.6 | ...... |
| 19 | 4.5 | 4.05 | (a) | 5.1 | 4.3 | 4.2 | 4.35 | 4.35 | 3.5 | 4.3 | 3.55 | ...... |
| 20 | 4.55 | 4.0 | (1.5) | 5.0 | 4.3 | 4.2 | 4.35 | 4.35 | 3.9 | 4.3 | 3.4 | ...... |
| 21 | 4.5 | 3.9 | 3.35 | 5.0 | 4.3 | 4.2 | 4.35 | 4.35 | 4.05 | 4.3 | 3.4 | ...... |
| 22 | 4.55 | 3.9 | 3.5 | 5.0 | 4.25 | 4.25 | 4.3 | 4.3 | 4.2 | 4.3 | 3.4 | ...... |
| 23 | 4.5 | 3.95 | 3.8 | 4.9 | 4.3 | 4.3 | 4.3 | 4.3 | 4.35 | (a) | 3.2 | ...... |
| 24 | 4.35 | 4.1 | 4.15 | 4.95 | 4.3 | 4.3 | 4.3 | 4.3 | 4.35 | (a) | 3.05 | ...... |
| 25 | 4.25 | 4.3 | (4.5) | 4.9 | 4.3 | 4.25 | 4.35 | 4.3 | 4.3 | (a) | 3.05 | ...... |
| 26 | 4.2 | 4.4 | (4.8) | 4.9 | 4.3 | 4.25 | 4.3 | 4.3 | 4.25 | (a) | 3.05 | ...... |
| 27 | 4.05 | 4.5 | (4.8) | 4.9 | 4.3 | 4.25 | 4.3 | 4.3 | 4.25 | .1 | 3.05 | ...... |
| 28 | 3.95 | 4.5 | (4.8) | 4.9 | 4.3 | 4.25 | 4.3 | 4.3 | 4.25 | .8 | 3.05 | ...... |
| 29 | 3.9 | ....... | (4.8) | 4.8 | 4.3 | 4.25 | 4.3 | 4.3 | 4.25 | .85 | 3.4 | ...... |
| 30 | 3.85 | ....... | 4.8 | 4.6 | 4.2 | 4.25 | 4.3 | 4.3 | 3.1 | 1.7 | 3.45 | ...... |
| 31 | 3.85 | ....... | 4.7 | ....... | 4.2 | ....... | 4.25 | 4.3 | ....... | 1.7 | ....... | ...... |

[a] No flow.

NOTE.—Gage heights in parentheses are estimated.

*Estimated monthly discharge of Main canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 600 | 398 | 500 | 30,740 |
| February | 595 | 416 | 470 | 26,100 |
| March | 672 | 0 | 261 | 16,050 |
| April | 752 | 634 | 719 | 42,780 |
| May | 648 | 566 | 598 | 36,770 |
| June | 582 | 548 | 570 | 33,920 |
| July | 593 | 556 | 575 | 35,360 |
| August | 568 | 536 | 553 | 34,000 |
| September | 570 | 0 | 369 | 21,960 |
| October | 561 | 0 | 328 | 20,170 |
| November | 390 | 220 | 351 | 20,890 |
| The period | | | ........ | 318,700 |

*Discharge measurements of Boundary canal near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 3 | W. V. Hardy | 0.80 | 6.4 |
| January 11 | do | .98 | 8.6 |
| January 18 | do | 1.00 | 8.9 |
| January 25 | do | | 7.8 |
| February 2 | do | .99 | 9.1 |
| February 9 | do | .95 | 8.3 |
| February 17 | R. R. McCoslin | .79 | 5.3 |
| February 23 | do | .98 | 8.3 |
| March 1 | do | 1.00 | 10.0 |
| March 5 | do | | 0 |
| March 8 | do | | 0 |
| March 22 | do | .88 | 7.8 |
| March 29 | do | .80 | 6.2 |
| April 5 | do | .85 | 8.5 |
| April 11 | do | .99 | 10.4 |
| April 17 | do | 1.00 | 11.7 |
| April 24 | do | 1.08 | 13.0 |
| May 1 | do | .83 | 6.1 |
| May 8 | do | .83 | 7.5 |
| May 15 | do | .74 | 6.1 |
| May 22 | do | .71 | 5.1 |
| May 29 | do | .85 | 8.0 |
| June 5 | do | .90 | 8.4 |
| June 12 | R. R. McCoslin | 0.35 | 0.22 |
| June 18 | do | 1.00 | 11.0 |
| June 26 | do | .91 | 7.5 |
| July 3 | do | .93 | 6.4 |
| July 10 | do | .78 | 4.8 |
| July 17 | do | .77 | 4.2 |
| July 24 | do | .96 | 6.6 |
| July 31 | do | .87 | 5.3 |
| August 7 | do | .83 | 6.2 |
| August 14 | do | .78 | 5.7 |
| August 21 | do | .79 | 5.7 |
| August 28 | do | .79 | 4.8 |
| September 4 | do | .80 | 3.8 |
| September 11 | do | | 0 |
| October 2 | W. V. Hardy | | 0 |
| October 6 | do | .90 | 8.4 |
| October 9 | do | .87 | 5.3 |
| October 16 | do | .80 | 5.0 |
| October 18 | do | .25 | 0 |
| October 30 | do | .85 | 8.0 |
| November 13 | do | .90 | 8.4 |
| November 18 | do | .95 | 7.0 |
| November 30 | do | 1.03 | 12.7 |

*Estimated monthly discharge of Boundary canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 8.9 | 6.0 | 8.1 | 498 |
| February | 9.8 | 5.1 | 7.8 | 433 |
| March | 10.0 | 0 | 3.6 | 221 |
| April | 13.0 | 7.0 | 10.2 | 607 |
| May | 8.0 | 5.1 | 6.5 | 400 |
| June | 11.0 | .2 | 7.9 | 471 |
| July | 6.8 | 4.2 | 5.4 | 332 |
| August | 6.2 | 4.4 | 5.6 | 344 |
| September | 6.0 | 0 | 3.8 | 227 |
| October | 8.0 | 0 | 4.4 | 271 |
| November | 12.7 | 7.0 | 9.0 | 536 |
| The period | | | | 4,340 |

*Discharge measurements of Wisteria canal near Calexico, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* |
| January 5 | W. V. Hardy | 1.12 | 3.0 |
| January 11 | do | .15 | [a]0 |
| January 18 | do | .52 | 7.7 |
| January 25 | do | .92 | 22 |
| February 1 | do | .80 | 16.5 |
| February 10 | do | | 0 |
| February 18 | do | | 0 |
| February 25 | R. R. McCoslin | | 0 |
| March 1 | do | | 0 |
| March 15 | do | | 0 |
| March 23 | do | | 0 |
| March 29 | do | .90 | 26 |
| April 6 | do | 1.65 | 64 |
| April 12 | do | 1.29 | 47 |
| April 18 | do | 1.00 | 33 |
| April 25 | do | .95 | 32 |
| May 2 | do | .50 | 13.1 |
| May 9 | do | .85 | 26 |
| May 16 | do | .43 | 12.2 |
| May 23 | do | .63 | 17.1 |
| May 30 | do | .42 | 12.1 |
| June 6 | do | .38 | 11.9 |
| June 13 | R. R. McCoslin | 0.35 | 10.6 |
| June 19 | W. V. Hardy | .57 | 13.5 |
| June 26 | R. R. McCoslin | .38 | 10.6 |
| July 5 | do | .30 | 9.4 |
| July 11 | do | .96 | 32 |
| July 18 | do | .66 | 17.8 |
| July 25 | W. V. Hardy | | 0 |
| August 1 | do | .33 | 7.8 |
| August 8 | do | | 0 |
| August 15 | R. R. McCoslin | | 0 |
| August 22 | W. V. Hardy | | 0 |
| August 29 | R. R. McCoslin | | 0 |
| September 5 | W. V. Hardy | | 0 |
| September 12 | do | | 0 |
| September 26 | do | | 0 |
| October 3 | do | | 0 |
| October 11 | do | | 0 |
| October 18 | do | .60 | 12.8 |
| October 31 | do | .60 | 14 |
| November 7 | do | .40 | 12 |
| November 14 | do | | 0 |
| November 21 | do | .15 | 0 |

[a] Estimated.

*Daily gage height, in feet, of Wisteria canal near Calexico, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.95 | 0.8 | 0.25 | 1.5 | 0.3 | 0.4 | 0.3 | 0.35 | 0 | 0.0 | 0.6 |
| 2 | .9 | .8 | .2 | 1.2 | .4 | .4 | .3 | .05 | 0 | .0 | .6 |
| 3 | 1.15 | .8 | .2 | 1.7 | .4 | .4 | .3 | .05 | 0 | .0 | .6 |
| 4 | 1.1 | 1.0 | .2 | 1.8 | .4 | .4 | .3 | .05 | 0 | .0 | .6 |
| 5 | 1.1 | .55 | .2 | 1.6 | .7 | .4 | .3 | .0 | 0 | .0 | .0 |
| 6 | 1.1 | .3 | .2 | 1.65 | .7 | .4 | .3 | .0 | 0 | .0 | .4 |
| 7 | 1.25 | .0 | .2 | 1.7 | .8 | .4 | .3 | .0 | 0 | .0 | .4 |
| 8 | 1.3 | .0 | .15 | 1.6 | .8 | .4 | .3 | .0 | 0 | .0 | .75 |
| 9 | .95 | .0 | .15 | 1.5 | .8 | .4 | .3 | .0 | 0 | .0 | .75 |
| 10 | .95 | .0 | .15 | 1.45 | .8 | .3 | .3 | .0 | 0 | .0 | .0 |
| 11 | .15 | .0 | .15 | 1.35 | .5 | .3 | .95 | .0 | 0 | .0 | .0 |
| 12 | .1 | .3 | .35 | 1.15 | .45 | .3 | 1.8 | .0 | 0 | .0 | .0 |
| 13 | .1 | .2 | .35 | 1.1 | .45 | .3 | 1.1 | .0 | 0 | 0.6 | .0 |
| 14 | .0 | .25 | .40 | .95 | .45 | .25 | 1.0 | .0 | 0 | .6 | .0 |
| 15 | .0 | .3 | .35 | 1.0 | .45 | .25 | 1.0 | .0 | 0 | .6 | .5 |
| 16 | .0 | .35 | .3 | 1.0 | .45 | .3 | .9 | .0 | 0 | .6 | .0 |
| 17 | .6 | .25 | .3 | 1.0 | .45 | .0 | .6 | .0 | 0 | .6 | .0 |
| 18 | .2 | .1 | .3 | 1.0 | .45 | .0 | .65 | .0 | 0 | .6 | .0 |
| 19 | .65 | .0 | .5 | .8 | .75 | .4 | .5 | .0 | 0 | .6 | .0 |
| 20 | .8 | .0 | .5 | .7 | .8 | .4 | .5 | .0 | 0 | .6 | .0 |
| 21 | .8 | .0 | .5 | .65 | .8 | .4 | .5 | .0 | 0 | .45 | .15 |
| 22 | .8 | .0 | .5 | 1.0 | .7 | .4 | .45 | .0 | 0 | .45 | .35 |
| 23 | .8 | .0 | .8 | .1 | .6 | .4 | .0 | .0 | 0 | .0 | .35 |
| 24 | .9 | .0 | .8 | .9 | .6 | .4 | .0 | .0 | 0 | .0 | .1 |
| 25 | .9 | .0 | .8 | 1.1 | .7 | .4 | .0 | .0 | 0 | .0 | .0 |
| 26 | 1.0 | .2 | .65 | 1.15 | .7 | .4 | .0 | .0 | 0 | .0 | .0 |
| 27 | 1.1 | .2 | .6 | .9 | .65 | .4 | .0 | .0 | 0 | .05 | .0 |
| 28 | 1.0 | .3 | .8 | .45 | .65 | .3 | .0 | .0 | 0 | .05 | .0 |
| 29 | 1.0 | ....... | .9 | .4 | .4 | .2 | .0 | .0 | 0 | .6 | .0 |
| 30 | 1.0 | ....... | 1.0 | .35 | .4 | .3 | .1 | .0 | 0 | .6 | .0 |
| 31 | .8 | ....... | 1.15 | ....... | .4 | ....... | .35 | .0 | 0 | .6 | ...... |

*Estimated monthly discharge of Wisteria canal near Calexico, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 40 | 0 | 17.9 | 1,100 |
| February | 25 | 0 | 3.8 | 211 |
| March | 32 | 0 | 7.1 | 436 |
| April | 75 | 0 | 39.5 | 2,325 |
| May | 25 | 0 | 16.7 | 1,027 |
| June | 12 | 0 | 9.6 | 572 |
| July | 80 | 0 | 14.2 | 873 |
| August | 11 | 0 | .4 | 25 |
| September | 0 | 0 | .0 | 0 |
| October | 14 | 0 | 5.4 | 332 |
| November | 25 | 0 | 5.6 | 334 |
| The period | .......... | .......... | .......... | 7,261 |

*Discharge measurements of Tamarack canal near Imperial, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet.* | *Sec.-ft.* |
| May 25 | W. V. Hardy | | 52 | October 19 | W. V. Hardy | | [a] 40 |
| June 1 | R. R. McCoslin | 1.70 | 51 | October 26 | do | | [a] 40 |
| June 8 | W. V. Hardy | 1.80 | 56 | November 2 | do | | [a] 40 |
| June 14 | do | 1.64 | 43 | November 9 | do | | [a] 40 |
| June 22 | do | 14.50 | 14 | November 16 | do | | [a] 40 |
| October 4 | do | | [a] 40 | November 23 | do | | [a] 30 |
| October 12 | do | | [a] 40 | | | | |

[a] Estimated.

*Daily gage height, in feet, of Tamarack canal near Imperial, Cal., for 1905.*

| Day. | June. | Day. | June. | Day. | June. | Day. | June. | Day | June. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 7 | 1.8 | 13 | 1.35 | 19 | 1.65 | 25 | 1.2 |
| 2 | 1.68 | 8 | 1.8 | 14 | 1.65 | 20 | 1.75 | 26 | 1.05 |
| 3 | 1.7 | 9 | 1.8 | 15 | 1.65 | 21 | 1.5 | 27 | 1.0 |
| 4 | 1.55 | 10 | 1.9 | 16 | 1.6 | 22 | 1.45 | 28 | .9 |
| 5 | 1.65 | 11 | 1.95 | 17 | 1.65 | 23 | 1.35 | 29 | .9 |
| 6 | 1.75 | 12 | 2.05 | 18 | 1.7 | 24 | 1.2 | 30 | .7 |

*Estimated monthly discharge of Tamarack canal near Imperial, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| June | | | 34.3 | 2,041 |
| July | | | (40) | 2,460 |
| August | | | (40) | 2,460 |
| September | | | (40) | 2,380 |
| October | | | (40) | 2,460 |
| November | | | (40) | 2,380 |
| The period | | | | 14,180 |

NOTE.—Monthly means in parenthesis estimated in the field.

*Total amount of water (in acre-feet) entering the Imperial Valley through irrigation canals at international boundary, January to November, 1905, inclusive.*

| Canal. | January. | February. | March. | April. | May. | June. |
|---|---|---|---|---|---|---|
| Hemlock | 263 | 555 | 658 | 1,149 | 965 | 839 |
| Boundary | 249 | 216.5 | 110.5 | 303.5 | 200 | 235.5 |
| Wisteria | 1,100 | 211 | 436 | 2,351 | 1,027 | 572 |
| Tamarack | ........ | ........ | ........ | ........ | ........ | 2,041 |
| New Holt, or No. 7 | ........ | ........ | ........ | ........ | 1,107 | 1,964 |
| Main | 30,744 | 26,102 | 16,048 | 42,783 | 36,770 | 33,917 |
| Alamitos | 1,636 | 633 | 301 | 2,714 | 1,955 | 2,047 |
| Holt, or No. 5 Main | 1,525 | 1,162 | 3,530 | 12,377 | 9,346 | 8,926 |
| Alamo Channel | 5,500 | 8,330 | 9,223 | ........ | ........ | ........ |
| Total | 41,017 | 37,209 | 30,306 | 61,677 | 51,370 | 50,541 |

| Canal. | July. | August. | September. | October. | November. | Total. |
|---|---|---|---|---|---|---|
| Hemlock | 670 | 639 | 482 | 461 | 274 | 6,955 |
| Boundary | 166 | 172 | 113.5 | 135.5 | 268 | 2,170 |
| Wisteria | 873 | 25 | 0 | 332 | 334 | 7,261 |
| Tamarack | 2,460 | 2,460 | 2,380 | 2,460 | 2,380 | 14,181 |
| New Holt, or No. 7 | 2,029 | 2,029 | 1,964 | 2,029 | 1,964 | 13,086 |
| Main | 35,355 | 34,003 | 21,957 | 20,168 | 20,886 | 318,733 |
| Alamitos | 2,084 | 1,470 | 2,428 | 2,201 | 161 | 17,630 |
| Holt, or No. 5 Main | 9,223 | 9,223 | 8,569 | 5,940 | 1,607 | 71,428 |
| Alamo Channel | ........ | ........ | ........ | ........ | ........ | 23,053 |
| Total | 52,860 | 50,021 | 37,893 | 33,726 | 27,874 | 474,494 |

*Total amount of water (in acre-feet) entering Imperial Valley, including canals, New River, and Alamo Channel; also amount of waste water discharging into Salton Sea and amount used for irrigation, January to November, 1905, inclusive.*

| Month. | Total discharge Imperial canal at headings below Yuma, Ariz. | Total discharge into Imperial Valley. | Total discharge (waste) into Salton Sea. | Total amount of water used for irrigation. |
|---|---|---|---|---|
| | *Acre-feet.* | *Acre-feet.* | *Acre-feet.* | *Acre-feet.* |
| January | 58,100 | 55,590 | 35,356 | 20,234 |
| February | 227,150 | 92,913 | 77,919 | 14,994 |
| March | 288,990 | 210,896 | 194,548 | 16,348 |
| April | 233,550 | 223,171 | 182,494 | 40,677 |
| May | 335,420 | 321,239 | 287,869 | 33,370 |
| June | 573,020 | 622,911 | 587,370 | 35,541 |
| July | 1,104,620 | 1,037,724 | 978,244 | 50,480 |
| August | 609,030 | 597,751 | 564,946 | 32,805 |
| September | 365,360 | [a]353,360 | 324,869 | 28,491 |
| October | 468,840 | [a]456,840 | 435,227 | 21,613 |
| November | 500,000 | [a]488,000 | 477,977 | 10,023 |
| Total | 4,764,080 | 4,460,395 | 4,155,819 | 304,576 |

[a] Estimated.

Total amount of irrigated land (as per examination made in March and April, 1905)...acres... 79,591

Amount of water used per acre (in acre-feet)... 3.83

### LANDS IRRIGATED IN THE IMPERIAL VALLEY.

In April, 1904, an examination was made to determine the amount of lands irrigated in the valley. The gross area under irrigation at that time was 66,741 acres. A second examination was made in September of the same year by W. V. Hardy, of the Reclamation Service, and showed the total area irrigated at that time to be 31,318 acres. Another examination by Mr. Hardy in March and April, 1905, gave a total irrigated area of 79,591 acres.

The examination of area of irrigated land made in March and April, 1905, is used in computing the amount of water per acre used during 1905. It is probable that this area was greatly reduced during the summer, as areas for the raising of hay and grain were not again used after the crops were harvested until the late fall months, when they were again seeded. Large areas of alfalfa and Kaffir corn were necessarily irrigated throughout the year.

### DUTY OF WATER IN THE IMPERIAL VALLEY.

During the fall of 1904 rating flumes were placed on two canals in Imperial Valley for the study of the duty of water. Two types of soil were selected for these investigations, one known as "hard soil" and classified as "Imperial loam" as shown on soil map of Bureau of Soils, United States Department of Agriculture. The other type is known as "soft soil" and classified as "Imperial sandy loam."

The location of the investigation on "Imperial loam" is at the ranch of W. W. McKim, 7 miles east of Imperial, being the west half of sec. 8, T. 15 S., R. 14 E.

The location of the investigation on "Imperial sandy loam" is on lands of the California-Mexico Land Company, 3½ miles east of Mexicala in Mexican territory and directly south of the California-Mexico boundary line in T. 17 S., R. 15 E.

Permanent flumes were constructed at the head of each of these canals and a sufficient number of measurements were made throughout the year for rating them. Self-recording registers were placed at each of these stations, and the mean daily gage height was computed from the register records.

During 1905 the Imperial Valley received a very unusual rainfall. The precipitation at Imperial was 10.06 inches for the year. At Calexico the precipitation was 9.33 inches for the year. The mean annual rainfall will probably not exceed 3 inches in normal years.

### M'KIM FLUME.

This station was established on September 23, 1904. The amount of land irrigated under this flume is 380 acres. The soil is classified as "Imperial loam." The crops raised during 1905 consisted of 100 acres in barley, which was sown in October, 1904. The crop was only fair and was used for the pasturage of hogs. The balance of the area, 280 acres, had been previously planted to alfalfa, 100 acres having been sown in October, 1902, and 100 acres in October, 1903. This area in alfalfa was in fair condition at the time the station was established. The crop of 1905 was fair and used only for the pasturage of hogs. The supply of water furnished for this area was not enough for thorough irrigation. Water was taken from Alamo channel until March, 1905, and up to this time the supply was sufficient for thorough irrigation. After March, 1905, water was taken from Alamitos canal on account of flood conditions in the Alamo channel which destroyed the levee at point where the diversion was made. The water supply received from the Alamitos canal was not enough for the thorough irrigation of this area and crops suffered considerably from lack of water after March.

The rainfall for this station is taken from the United States Weather Bureau records kept at Imperial, Cal.

*Monthly duty of water under McKim flume during 1905.*

| Month. | Acre-feet. | | Rainfall in inches. |
|---|---|---|---|
| | Total. | Per acre. | |
| January | 24.6 | 0.06 | 1.50 |
| February | 16.7 | .04 | 6.12 |
| March | 12.3 | .03 | 1.05 |
| April | 114.0 | .30 | .15 |
| May | 85.6 | .22 | .00 |
| June | 108.0 | .28 | .00 |
| July | 79.4 | .21 | .07 |
| August | 61.0 | .16 | .00 |
| September | 71.9 | .19 | .04 |
| October | 49.2 | .13 | .00 |
| November | 17.9 | .05 | .83 |
| December | 49.2 | .13 | .30 |
| Total irrigation | 689.8 | 1.81 | 10.06 |
| Total, including rainfall | ............ | 2.64 | ............ |

### CALIFORNIA-MEXICO LAND AND CATTLE COMPANY'S FLUME.

This station was established November 28, 1904. It is located 3½ miles east of Mexicala. The total area irrigated under this flume is 575 acres. The soil is classified as "Imperial sandy loam." In December, 1904, the entire area was sown to barley, 75 acres were cut for hay, averaging 1¼ tons to the acre, the balance of the acreage was used for pasturage. The crop was equally as good over the entire area as that on the 75 acres which was cut for hay. In May, 1905, the entire area was sown to Kaffir corn. This crop was poor and scattering and used in the fall for pasturage. This area received an ample supply of water for the crops raised.

The rainfall for this station is taken from the United States Weather Bureau records kept at Calexico, Cal.

*Monthly duty of water under California-Mexico Land and Cattle Company's flume during 1905.*

| Month. | Acre-feet. | | Rainfall in inches. |
|---|---|---|---|
| | Total. | Per acre. | |
| January | 67.6 | 0.12 | 1.50 |
| February | 5.6 | .01 | 3.76 |
| March | 30.7 | .05 | .91 |
| April | 113.0 | .20 | .50 |
| May | 313.0 | .55 | .00 |
| June | 214.0 | .37 | .00 |
| July | 332.0 | .58 | .03 |
| August | 289.0 | .50 | .00 |
| September | 131.0 | .23 | .13 |
| October | 91.7 | .16 | .00 |
| November | 66.0 | .11 | 1.96 |
| December | 104.0 | .18 | .54 |
| Total irrigation | 1,757.6 | 3.06 | 9.33 |
| Total, including rainfall | ............ | 3.84 | ............ |

### MISCELLANEOUS MEASUREMENTS IN COLORADO RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in canals in the Colorado River drainage basin by W. D. Smith during 1905:

*Miscellaneous discharge measurements made in Colorado River drainage basin in 1905.*

| Date. | Locality. | Width. | Area of section. | Mean velocity. | Discharge. |
|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| February 15 ... | Imperial canal in Mexico immediately below Quail River waste gate.[a] | ........ | 560 | 3.46 | 1,937 |
| February 28 ... | .....do ........ | ........ | 556 | 3.28 | 1,821 |
| December 17... | Imperial canal in Mexico immediately below Quail River cut-off.[b] | 170 | 1,640 | 3.21 | 5,265 |
| December ..... | Quail River cut-off in Mexico at point of diversion from Imperial canal.[b] | 150 | 632 | 2.68 | 1,693 |

[a] Quail River waste gate is in Mexico, 12 miles below heading No. 1 of the Imperial canal. Gagings by means of boat and cable were made at this point February 15 and 28 to determine amount of water being carried to Imperial Valley by the canal.

[b] For location and significance of this gaging see general description of Imperial canal, page 21. A measurement was made by means of boat and cable.

## THE GREAT BASIN DRAINAGE.

### GENERAL FEATURES.

The Great Basin drainage in California is comprised within the subdrainages, Sierra Nevada and Minor Great Basin. Within the Sierra Nevada drainage is a limited area of arid country lying on the eastern slope of the Sierra Nevadas. This area includes the Susan and Owens River drainage basins. Within the Minor Great Basin drainage lies the Mohave River drainage basin. Having no outlet to the sea, the entire drainage of these basins is lost mainly through evaporation from the lakes and sinks in which the waters of these rivers collect.

## SUSAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Susan River has its source in the Sierra Nevada in northeastern California, and flows eastward, discharging into Honey Lake—one of the landlocked lakes of the Great Basin—of which it is the principal feeder. A considerable area of land is irrigated from the waters of the river below the gaging station, and during the last ten or twelve years several projects have been started for irrigating other extensive areas by the storage of its waters both above and below the town of Susanville.

### SUSAN RIVER NEAR SUSANVILLE, CAL.

This station was established June 3, 1900, by L. H. Taylor. It is located about three-fourths of a mile southwest of Susanville, at the electric light plant.

The channel is straight for 150 feet above and 250 feet below the station. The current is swift. There is a riffle immediately above the cable. The right bank is high and is composed of clay covered with vegetation. It is not liable to overflow. The left bank is low, liable to overflow, and covered with a sparse growth of willows. The bed of the stream is composed of gravel and cobblestones and is permanent. A short distance above the station a small irrigating ditch, known as the "Masten ditch," is taken out on the right bank.

High-water measurements are made by means of a cable and car. Measurements at low and ordinary stages are made by wading. The initial point for soundings is a post in the fence in line with the cable, 34.8 feet from the cable support on the left bank.

On December 20, 1903, the station was reestablished, and the datum of the gage was raised 2.00 feet. A gage is also placed in the flume near the head of Masten ditch. During 1905 the gage was read once each day by James Branham. Bench marks were established as follows: (1) A nail in the fence post which is used as the initial point for soundings; elevation, 11.35 feet. (2) A nail in the cable post: elevation, 9.00 feet. (3) A nail in the cottonwood tree to which the cable is attached; elevation, 10.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 408; 66, pp 115-116; 85, p 123; 100, pp 204-205; 133, p 197.
Discharge: 51, p 408; 66, p 116; 100, p 205; 133, p 197.
Discharge, monthly: 75, p 190; 133, p 198.
Gage heights: 51, p 408; 66, p 116; 85, p 124; 100. p 205; 133. p 198.
Rating table: 566, p 175.

*Discharge measurements of Susan River near Susanville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 21 | J. Branham | 44 | 92 | 4.79 | 6.60 | 441 |
| May 12 | do | 29 | 48 | 3.27 | 5.40 | 157 |
| June 12 | do | 25 | 31 | 2.32 | 4.70 | 72 |
| June 25 | do | 24 | 18 | 1.66 | 4.20 | 30 |
| July 23 | do | 18 | 10.8 | 1.19 | 3.85 | 12.8 |
| August 29 | do | 14 | 8.1 | 0.85 | 3.75 | 6.9 |
| September 26 | do | 19 | 13.6 | 1.13 | 4.00 | 15.4 |

*Daily gage height, in feet, of Susan River near Susanville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.95 | 5.2 | 5.25 | 6.15 | 5.95 | 5.15 | 4.1 | 4.1 | 3.8 | 3.8 | 4.0 | 4.0 |
| 2 | 4.8 | 5.2 | 5.25 | 5.95 | 5.9 | 5.1 | 4.1 | 4.1 | 3.8 | 3.8 | 4.0 | 4.0 |
| 3 | 4.75 | 5.2 | 5.25 | 5.95 | 5.8 | 5.05 | 4.45 | 4.1 | 3.8 | 3.9 | 4.0 | 4.0 |
| 4 | 4.7 | 5.2 | 5.25 | 5.9 | 5.8 | 5.05 | 4.8 | 4.1 | 3.8 | 3.95 | 4.0 | 4.0 |
| 5 | 4.65 | 5.15 | 5.25 | 5.9 | 5.65 | 5.0 | 4.6 | 4.1 | 3.85 | 3.95 | 4.0 | 4.0 |
| 6 | 4.6 | 5.05 | 5.25 | 6.0 | 5.55 | 5.0 | 4.4 | 4.1 | 3.85 | 3.95 | 4.0 | 4.0 |
| 7 | 4.6 | 4.85 | 5.25 | 6.1 | 5.5 | 5.0 | 4.25 | 4.1 | 3.85 | 4.0 | 4.0 | 4.0 |
| 8 | 4.55 | 4.85 | 5.25 | 6.1 | 5.5 | 4.9 | 4.1 | 4.0 | 3.85 | 3.95 | 4.0 | 4.0 |
| 9 | 4.55 | 4.75 | 5.2 | 6.1 | 5.5 | 4.85 | 4.1 | 3.9 | 3.85 | 3.9 | 4.0 | 4.0 |
| 10 | 4.55 | 4.8 | 5.2 | 6.2 | 5.45 | 4.75 | 4.0 | 3.8 | 3.85 | 3.9 | 4.0 | 4.0 |
| 11 | 4.55 | 4.7 | 5.2 | 6.1 | 5.4 | 4.7 | 4.0 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 12 | 4.6 | 4.65 | 5.4 | 6.1 | 5.4 | 4.7 | 4.0 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 13 | 4.65 | 4.55 | 5.9 | 6.1 | 5.35 | 4.65 | 3.95 | 3.8 | 3.9 | 3.9 | 4.0 | 4.0 |
| 14 | 4.7 | 4.5 | 5.9 | 6.1 | 5.3 | 4.65 | 4.2 | 3.8 | 3.85 | 3.9 | 4.0 | 4.0 |
| 15 | 4.7 | 4.45 | 6.05 | 6.1 | 5.3 | 4.6 | 4.2 | 3.75 | 3.85 | 3.9 | 4.0 | 4.0 |
| 16 | 4.7 | 4.45 | 6.1 | 6.1 | 5.4 | 4.5 | 4.2 | 3.75 | 3.8 | 3.9 | 4.0 | 4.0 |
| 17 | 4.7 | 4.5 | 6.05 | 6.05 | 5.4 | 4.5 | 4.0 | 3.75 | 3.8 | 4.0 | 4.0 | 4.0 |
| 18 | 4.65 | 4.55 | 6.0 | 6.05 | 5.4 | 4.4 | 4.0 | 3.75 | 3.8 | 4.05 | 4.0 | 4.0 |
| 19 | 4.65 | 5.05 | 6.6 | 6.05 | 5.4 | 4.4 | 4.1 | 3.75 | 3.9 | 4.0 | 4.0 | 4.0 |
| 20 | 4.65 | 5.35 | 6.25 | 5.95 | 5.4 | 4.4 | 4.05 | 3.75 | 3.9 | 4.0 | 4.0 | 4.0 |
| 21 | 4.65 | 5.35 | 6.45 | 5.8 | 5.4 | 4.3 | 3.9 | 3.8 | 3.95 | 4.0 | 4.0 | 4.0 |
| 22 | 4.8 | 5.25 | 6.15 | 5.8 | 5.4 | 4.3 | 3.9 | 3.8 | 3.95 | 4.0 | 4.0 | 4.0 |
| 23 | 5.5 | 5.1 | 6.1 | 5.8 | 5.35 | 4.25 | 3.85 | 3.8 | 3.95 | 4.0 | 4.05 | 4.0 |
| 24 | 5.4 | 5.1 | 6.05 | 5.85 | 5.35 | 4.2 | 3.85 | 3.75 | 3.95 | 4.0 | 4.05 | 4.0 |
| 25 | 5.2 | 5.2 | 5.85 | 5.9 | 5.3 | 4.2 | 3.85 | 3.75 | 3.95 | 4.0 | 4.1 | 4.0 |
| 26 | 4.95 | 5.2 | 6.9 | 6.0 | 5.3 | 4.2 | 3.85 | 3.75 | 4.0 | 4.0 | 4.1 | 4.0 |
| 27 | 4.9 | 5.25 | 6.3 | 6.0 | 5.3 | 4.2 | 3.8 | 3.75 | 3.9 | 4.0 | 4.1 | 4.0 |
| 28 | 4.9 | 5.25 | 6.1 | 6.0 | 5.25 | 4.2 | 3.8 | 3.75 | 4.0 | 4.0 | 4.05 | 4.0 |
| 29 | 4.85 | ....... | 6.0 | 6.0 | 5.25 | 4.15 | 3.75 | 3.8 | 3.95 | 4.0 | 4.05 | 4.0 |
| 30 | 4.8 | ....... | 6.1 | 6.0 | 5.2 | 4.15 | 3.75 | 3.8 | 3.9 | 4.0 | 4.0 | 4.0 |
| 31 | 4.8 | ....... | 6.0 | ....... | 5.2 | ....... | 4.1 | 3.8 | ....... | 4.0 | ....... | 4.0 |

*Station rating table for Susan River near Susanville, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.75 | 7 | 4.60 | 59 | 5.50 | 168 | 6.40 | 356 |
| 3.80 | 9 | 4.70 | 68 | 5.60 | 185 | 6.50 | 382 |
| 3.90 | 13 | 4.80 | 77 | 5.70 | 203 | 6.60 | 410 |
| 4.00 | 18 | 4.90 | 87 | 5.80 | 222 | 6.70 | 440 |
| 4.10 | 24 | 5.00 | 98 | 5.90 | 242 | 6.80 | 470 |
| 4.20 | 30 | 5.10 | 110 | 6.00 | 262 | 6.90 | 500 |
| 4.30 | 37 | 5.20 | 123 | 6.10 | 284 | | |
| 4.40 | 44 | 5.30 | 137 | 6.20 | 307 | | |
| 4.50 | 51 | 5.40 | 152 | 6.30 | 331 | | |

NOTE.—The above table is based on 11 discharge measurements made during 1904 and 1905 and is well defined.

*Estimated monthly discharge of Susan River near Susanville, Cal., for 1905.*

[Drainage area, 256 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 168 | 55 | 76.9 | 4,728 | 0.300 | 0.346 |
| February | 144 | 48 | 96.9 | 5,382 | .379 | .395 |
| March | 500 | 123 | 234 | 14,390 | .914 | 1.05 |
| April | 307 | 222 | 264 | 15,710 | 1.03 | 1.15 |
| May | 252 | 123 | 160 | 9,838 | .625 | .721 |
| June | 116 | 27 | 61.3 | 3,648 | .239 | .267 |
| July | 77 | 7 | 23.4 | 1,439 | .091 | .105 |
| August | 24 | 7 | 12.1 | 744 | .047 | .054 |
| September | 18 | 9 | 12.3 | 732 | .048 | .054 |
| October | 21 | 9 | 15.7 | 965 | .061 | .070 |
| November | 24 | 18 | 19.0 | 1,131 | .074 | .083 |
| December | 18 | 18 | 18.0 | 1,107 | .070 | .081 |
| The year | 500 | 7 | 82.8 | 59,810 | .323 | 4.38 |

## WILLOW CREEK AT MERRILLVILLE, CAL.

This station was established June 18, 1904, by S. G. Bennett. It is located at the old bridge, 100 feet above the present wagon bridge at Merrillville.

The channel is straight above and below the bridge for 100 feet. The banks on each side are low, but not subject to overflow, and there is very little fluctuation in the discharge of the creek. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made from the bridge. The initial point for soundings is on the left bank of the stream.

The gage is a staff fastened vertically to the left end of the bridge. During 1905 the gage was read once each day by R. W. Hurlbut.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey, pages 199–200.

*Daily gage height, in feet, of Willow Creek at Merrillville, Cal., in 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 1.1 | 0.95 | 1.1 | 0.9 | 0.95 | 0.9 | 0.95 | 1.0 | 1.1 | 1.3 | 1.25 |
| 2 | 1.05 | 1.1 | 1.0 | 1.05 | .9 | .95 | .9 | .95 | 1.0 | 1.1 | 1.25 | 1.3 |
| 3 | 1.0 | 1.1 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 4 | 1.0 | 1.05 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 5 | 1.0 | 1.1 | .95 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.3 |
| 6 | 1.0 | 1.05 | .95 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.2 | 1.2 | 1.3 |
| 7 | 1.0 | 1.0 | 1.0 | 1.0 | .95 | .95 | .9 | .95 | 1.0 | 1.3 | 1.2 | 1.3 |
| 8 | 1.0 | 1.0 | 1.05 | 1.0 | .95 | 1.0 | .9 | .95 | 1.0 | 1.2 | 1.2 | 1.3 |
| 9 | 1.0 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .9 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 10 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .95 | .95 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 11 | 1.0 | 1.0 | 1.0 | .95 | 1.05 | .95 | .95 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 12 | 1.0 | 1.0 | 1.0 | .95 | 1.1 | .95 | 1.05 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 13 | 1.0 | 1.0 | 1.05 | 1.0 | 1.05 | .95 | 1.05 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 14 | 1.05 | 1.0 | .95 | 1.0 | 1.0 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 15 | 1.05 | .95 | 1.05 | 1.0 | .95 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 16 | 1.05 | 1.0 | 1.1 | 1.0 | .9 | .95 | 1.0 | 1.0 | 1.0 | 1.2 | 1.2 | 1.3 |
| 17 | 1.05 | 1.0 | 1.1 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 18 | 1.05 | 1.0 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 19 | 1.05 | 1.25 | 1.1 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 20 | 1.0 | 1.15 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 21 | 1.05 | 1.05 | 1.05 | 1.0 | .9 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 22 | 1.1 | 1.05 | 1.05 | 1.0 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 23 | 1.1 | 1.05 | 1.05 | .9 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 24 | 1.1 | 1.0 | 1.0 | .9 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 25 | 1.05 | 1.0 | 1.0 | .95 | .95 | .95 | .95 | 1.0 | 1.05 | 1.25 | 1.2 | 1.3 |
| 26 | 1.0 | 1.05 | 1.1 | .95 | 1.0 | .95 | .95 | 1.0 | 1.05 | 1.2 | 1.2 | 1.3 |
| 27 | 1.0 | 1.0 | 1.1 | .95 | 1.0 | .95 | .95 | 1.0 | 1.1 | 1.2 | 1.2 | 1.3 |
| 28 | 1.0 | 1.0 | 1.0 | .95 | 1.0 | .95 | .95 | 1.0 | 1.15 | 1.2 | 1.25 | 1.3 |
| 29 | 1.0 | ....... | 1.1 | .9 | .95 | .95 | .95 | 1.0 | 1.2 | 1.2 | 1.25 | 1.3 |
| 30 | 1.0 | ....... | 1.05 | .9 | .95 | .9 | .95 | 1.0 | 1.1 | 1.2 | 1.25 | 1.3 |
| 31 | 1.0 | ....... | 1.05 | ....... | .95 | ....... | .95 | 1.0 | ....... | 1.25 | ....... | 1.3 |

*Station rating table for Willow Creek at Merrillville, Cal., from July 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 16 | 1.10 | 20 | 1.20 | 22 | 1.30 | 24 |
| 1.00 | 18 | | | | | | |

NOTE.—The above table is based on four discharge measurements made during 1904, and is fairly well defined.

*Estimated monthly discharge of Willow Creek at Merrillville, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 20 | 18 | 18.5 | 1,138 |
| February | 23 | 17 | 18.8 | 1,044 |
| March | 20 | 17 | 18.6 | 1,144 |
| April | 20 | 16 | 17.6 | 1,047 |
| May | 20 | 16 | 17.1 | 1,051 |
| June | 18 | 16 | 17.0 | 1,012 |
| July | 19 | 16 | 16.9 | 1,039 |
| August | 18 | 17 | 17.7 | 1,088 |
| September | 22 | 18 | 18.7 | 1,113 |
| October | 24 | 20 | 21.9 | 1,347 |
| November | 24 | 22 | 22.2 | 1,321 |
| December | 24 | 23 | 24.0 | 1,476 |
| The year | 24 | 16 | 19.1 | 13,820 |

### WILLOW CREEK NEAR STANDISH, CAL.

This station was originally established June 4, 1900. It was reestablished January 1, 1905, and discontinued December 31 of the same year. It is located at the bridge on the road from Susanville to Hot Springs and is about 1½ miles above the junction of the creek with Susan River. It is about 4 miles west of north from Standish.

The channel is straight for 300 feet above and 250 feet below the station. The right bank is rather low and is subject to overflow at extreme high water; the left bank is high and not liable to overflow. The stream bed is sandy and liable to shift somewhat.

Discharge measurements are made from the bridge. The initial point for soundings is on the end of the bridge on the left bank.

The gage is a staff fastened vertically to the left abutment of the bridge. During 1905 the gage was read once each day by T. E. Ravenscroft

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 51, p 407; 66, p 115.
Discharge: 51, p 407.
Gage heights: 51, p 407; 66, p 115.

*Discharge measurements of Willow Creek near Standish, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 24 | J. Branham | 57 | 117 | 0.80 | 6.15 | 94 |
| January 29 | do | 57 | 87 | .79 | 5.35 | 69 |
| February 26 | do | 57 | 105 | .79 | 5.75 | 83 |
| April 23 | do | 32 | 21 | .95 | 4.00 | 20 |
| November 19 | do | 57 | 56 | .61 | 4.80 | 34 |

*Daily gage height, in feet, of Willow Creek near Standish, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.6 | 6.8 | 5.0 | 5.5 | 4.0 | 4.0 | 3.0 | 4.0 | 4.2 | 5.0 | 5.0 | 5.0 |
| 2 | 6.6 | 6.7 | 4.8 | 5.3 | 4.0 | 4.0 | 3.0 | 4.0 | 4.5 | 4.8 | 5.1 | 5.3 |
| 3 | 5.0 | 5.9 | 4.0 | 5.0 | 4.0 | 4.0 | 3.0 | 4.0 | 4.4 | 4.6 | 5.0 | 5.2 |
| 4 | 5.0 | ....... | 4.0 | 5.0 | 4.0 | 4.0 | 6.0 | 4.0 | 4.4 | 4.3 | 5.0 | 5.0 |
| 5 | 4.6 | 5.8 | 4.0 | 4.8 | 4.0 | 4.0 | 5.8 | 4.0 | 4.4 | 4.0 | 5.0 | 5.1 |
| 6 | 4.6 | 6.0 | 4.4 | 4.5 | 4.0 | 4.0 | 4.8 | 4.0 | 4.4 | 4.0 | 5.1 | 5.0 |
| 7 | 4.6 | 6.0 | 4.4 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.4 | 4.0 | 5.2 | 5.2 |
| 8 | 4.6 | 5.8 | 4.4 | 4.0 | 4.0 | 4.2 | 4.0 | 4.0 | 4.4 | 4.2 | 5.0 | 4.1 |
| 9 | 4.6 | 5.6 | 4.0 | 4.0 | 4.0 | 4.1 | 4.0 | 4.0 | 4.4 | 4.2 | 5.0 | 4.1 |
| 10 | 4.6 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 5.2 | 4.4 |
| 11 | 4.6 | 5.0 | 4.4 | 4.0 | 4.2 | 4.0 | 4.0 | 4.2 | 4.0 | 4.1 | 5.1 | 4.4 |
| 12 | 4.7 | 5.0 | 4.0 | 3.8 | 4.2 | 4.0 | 6.0 | 4.0 | 4.0 | 4.0 | 4.6 | 4.4 |
| 13 | 4.7 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.0 | 4.0 | 4.0 | 4.4 | 4.3 |
| 14 | 4.7 | 5.0 | 4.0 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 6.0 | 4.0 | 4.4 | 4.5 |
| 15 | 5.8 | 4.6 | 4.4 | 4.0 | 4.0 | 4.0 | 5.0 | 4.0 | 5.8 | 4.0 | 4.4 | 4.1 |
| 16 | 5.8 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 5.0 | 4.1 | 4.6 | 4.1 |
| 17 | 6.0 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.0 | 5.0 | 4.5 | 4.8 | 4.3 |
| 18 | 6.0 | 4.7 | 4.4 | 4.0 | 4.0 | 4.0 | 5.8 | 4.2 | 5.0 | 4.5 | 4.8 | 4.3 |
| 19 | 6.4 | 5.1 | 5.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.2 | 5.0 | 4.5 | 5.0 | 4.3 |
| 20 | 6.35 | 6.0 | 5.0 | 4.0 | 4.0 | 4.0 | 6.0 | 4.6 | 5.0 | 4.5 | 5.0 | 4.3 |
| 21 | 6.0 | 7.8 | 5.2 | 4.0 | 4.1 | 4.0 | 6.0 | 4.5 | 4.8 | 4.5 | 4.8 | 4.0 |
| 22 | 7.6 | 7.8 | 5.2 | 4.0 | 4.1 | 4.0 | 5.0 | 4.6 | 4.8 | 4.5 | 4.6 | 5.0 |
| 23 | 7.8 | 7.0 | 5.0 | 4.0 | 4.0 | 4.0 | 5.0 | 4.2 | 4.8 | 5.0 | 4.6 | 5.0 |
| 24 | 6.0 | 6.2 | 4.8 | 4.0 | 4.0 | 4.0 | 4.8 | 4.0 | 4.6 | 5.1 | 4.5 | 5.2 |
| 25 | 6.0 | 6.0 | 4.6 | 4.0 | 4.0 | 4.0 | 4.1 | 4.0 | 4.5 | 5.2 | 4.4 | 5.0 |
| 26 | 5.8 | 6.3 | 5.3 | 4.0 | 4.0 | 6.2 | 4.0 | 4.2 | 5.0 | 5.2 | 4.8 | 5.2 |
| 27 | 5.6 | 5.0 | 5.0 | 4.0 | 4.0 | 5.0 | 4.0 | 4.2 | 6.0 | 5.1 | 4.8 | 5.3 |
| 28 | 5.6 | 5.0 | 5.0 | 4.0 | 3.8 | 4.0 | 4.0 | 4.2 | 5.8 | 5.5 | 5.0 | 5.3 |
| 29 | 5.7 | ....... | 5.0 | 4.0 | 3.8 | 4.0 | 4.0 | 4.2 | 5.8 | 5.2 | 5.0 | 5.3 |
| 30 | 5.0 | ....... | 5.0 | 4.0 | 3.8 | 3.6 | 4.0 | 4.3 | 5.0 | 5.0 | 5.0 | 5.3 |
| 31 | 5.6 | ....... | 5.5 | ....... | ....... | ....... | 4.0 | 4.2 | ....... | 5.0 | ....... | 5.3 |

*Station rating table for Willow Creek near Standish, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.60 | 10 | 4.60 | 31 | 5.60 | 74 | 6.60 | 141 |
| 3.70 | 11 | 4.70 | 34 | 5.70 | 80 | 6.70 | 149 |
| 3.80 | 13 | 4.80 | 37 | 5.80 | 86 | 6.80 | 157 |
| 3.90 | 15 | 4.90 | 41 | 5.90 | 92 | 6.90 | 165 |
| 4.00 | 17 | 5.00 | 45 | 6.00 | 98 | 7.00 | 173 |
| 4.10 | 19 | 5.10 | 49 | 6.10 | 105 | 7.20 | 189 |
| 4.20 | 21 | 5.20 | 54 | 6.20 | 112 | 7.40 | 205 |
| 4.30 | 23 | 5.30 | 59 | 6.30 | 119 | 7.60 | 221 |
| 4.40 | 25 | 5.40 | 64 | 6.40 | 126 | 7.80 | 238 |
| 4.50 | 28 | 5.50 | 69 | 6.50 | 133 | | |

NOTE.—The above table is based on five discharge measurements made during 1905 and is not well defined.

*Estimated monthly discharge of Willow Creek near Standish, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 238 | 31 | 80.4 | 4,944 |
| February [a] | 238 | 31 | 89.4 | 4,965 |
| March | 69 | 17 | 33.5 | 2,060 |
| April | 69 | 17 | 22.9 | 1,363 |
| May [a] | 21 | 13 | 17.0 | 1,045 |
| June | 112 | 10 | 21.1 | 1,256 |
| July | 98 | 0 | 46.2 | 2,841 |
| August | 31 | 17 | 19.6 | 1,205 |
| September | 98 | 17 | 41.0 | 2,440 |
| October | 69 | 17 | 31.8 | 1,955 |
| November | 54 | 25 | 39.6 | 2,356 |
| December | 59 | 17 | 38.7 | 2,380 |
| The year | 238 | 0 | 40.1 | 28,810 |

[a] Discharge interpolated February 4 and May 31.

## OWENS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Owens River has its source in the Sierra Nevadas in eastern California and flows southeast parallel with this range, finally discharging its waters into Owens Lake. This basin has a length from north to south of approximately 150 miles with a width of from 20 to 25 miles. It lies between the Sierra Nevadas on the west and the White Mountains on the east. Practically the entire flow of this river is derived from the Sierra Nevadas, as it drains the entire eastern slope of this range from Mount Lyell on the north to a point some distance below Mount Whitney on the south. The White Mountains furnish no water for this stream except in times of exceptionally heavy rain storms, which seldom occur on this range. There are numerous tributaries entering Owens River from the west which have their source in the high elevations of the Sierra Nevadas, extending from the northern to the southern limits of this basin. The topography of the portion of the Sierra Nevadas which is drained by this stream is extremely rough and precipitous, the mountains rising abruptly from Owens Valley to elevations of 13,000 to 14,000 feet. The formation is of granite, with very little soil covering and sparse timber growth. Numerous lakes and marshes are found in the upper reaches of this portion of the drainage basin. Owens River, a short distance below its source, enters a flat, swampy country known as Long Valley, where a considerable quantity of its flow is used for the irrigation of meadow lands for stock raising. This water returns to the river channel at the lower end of this valley, at which point the stream enters a deep, narrow gorge with heavy grade. As the river breaks from this canyon it enters Owens Valley, through which it flows for a distance of about 80 miles, finally discharging into Owens Lake. The gaging station at Round Valley is located at the lower end of this canyon. Below this point numerous diversions are made for the irrigation of land in Owens Valley, where the soil is extensively cultivated and large areas are used for the raising of hay and grain. This country is particularly adapted to stock raising, which is carried on extensively throughout the valley. There are numerous opportunities for the construction of storage reservoirs within this basin, both on the main stream and also on the upper reaches of its tributaries, although none have been constructed as yet. The precipitation is extremely light within the area of this basin with the exception of the high elevations of the Sierra Nevadas, where there is a heavy fall of snow. The melting of the snow in the spring and summer months feeds the numerous tributaries of this river, insuring a continued flow throughout the year.

The gaging stations on canals taking water from Owens River may be considered as temporary. The gage rods in most instances are securely fastened to footbridges and are not liable to change. No permanent bench marks were established.

### OWENS RIVER NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the footbridge, 700 feet above the junction of Owens River and Rock Creek.

The river at this point cuts through a lava deposit about 100 feet thick and forms a gorge, which is about 250 feet wide at the top. The channel is straight for 175 feet above and 250 feet below the station. The current is swift at all stages. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of rock and lava bowlders and is not subject to much change.

Discharge measurements are made from the single-span footbridge to which the gage is attached. The bridge is 37 feet long and has a clear span of 35 feet. The initial point for soundings is the anchor bolt of the right abutment.

The gage is a vertical rod, fastened to the concrete bridge abutment on the left bank. During 1905 the gage was read once each day by T. E. Jones. The bench mark is a bolt set in a lava bowlder 97.4 feet north of the right abutment.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 206; 134, p 200.
Discharge: 100, p 206; 134, p 201.
Discharge, monthly: 134, p 203.
Gage heights, 100, p 207; 134, p 202.
Rating table: 134, p 203.

*Discharge measurements of Owens River near Round Valley, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 16 | R. J. Taylor | 34 | 73 | 2.52 | 1.97 | 184 |
| February 9 | do | 34 | 76 | 2.30 | 1.95 | 175 |
| April 4 | J. S. Evans | 34 | 72 | 2.49 | 2.00 | 179 |
| May 22 | do | 34 | 91 | 3.36 | 2.39 | 306 |
| June 27 | do | 34 | 102 | 3.74 | 2.58 | 382 |
| July 25 | do | 34 | 76 | 2.73 | 2.15 | 207 |
| August 15 | do | 34 | 72 | 2.12 | 1.90 | 154 |
| September 8 | do | 34 | 76 | 2.33 | 2.00 | 177 |
| September 27 | do | 34 | 72 | 2.15 | 1.90 | 155 |
| November 2 | F. R. S. Buttemer | 34 | 72 | 2.28 | 1.80 | 164 |
| November 24 | do | 34 | 75 | 2.40 | 1.85 | 180 |
| December 10 | do | 34 | 70 | 2.16 | 1.73 | 151 |

*Daily gage height, in feet, of Owens River near Round Valley, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.15 | 2.2 | 2.2 | 1.9 | 2.1 | 2.3 | 2.5 | 2.1 | 1.9 | 2.0 | 1.8 | 1.9 |
| 2 | 2.1 | 2.15 | 2.25 | 1.95 | 2.1 | 2.3 | 2.5 | 2.05 | 1.9 | 2.0 | 1.8 | 1.9 |
| 3 | 2.1 | 2.1 | 2.2 | 2.0 | 2.1 | 2.3 | 2.6 | 2.05 | 1.9 | 2.0 | 1.75 | 1.95 |
| 4 | 2.0 | 2.1 | 2.2 | 2.0 | 2.1 | 2.3 | 2.6 | 2.0 | 1.9 | 1.95 | 1.75 | 1.95 |
| 5 | 2.0 | 2.1 | 2.2 | 2.0 | 2.1 | 2.3 | 2.6 | 2.0 | 1.95 | 1.95 | 1.8 | 1.95 |
| 6 | 2.0 | 2.0 | 2.25 | 2.0 | 2.05 | 2.3 | 2.6 | 1.95 | 2.0 | 1.9 | 1.8 | 2.0 |
| 7 | 2.0 | 2.1 | 2.25 | 2.0 | 2.0 | 2.35 | 2.5 | 1.95 | 2.0 | 1.9 | 1.85 | 2.0 |
| 8 | 2.0 | 2.1 | 2.2 | 2.0 | 2.0 | 2.35 | 2.5 | 2.0 | 2.0 | 1.9 | 1.85 | 2.0 |
| 9 | 2.0 | 2.1 | 2.1 | 2.1 | 2.0 | 2.4 | 2.5 | 2.0 | 2.0 | 1.9 | 1.9 | 1.95 |
| 10 | 2.0 | 2.1 | 2.1 | 2.1 | 2.0 | 2.4 | 2.5 | 2.0 | 2.0 | 1.95 | 1.9 | 1.9 |
| 11 | 2.0 | 2.1 | 2.0 | 2.0 | 2.0 | 2.4 | 2.5 | 1.9 | 2.0 | 1.95 | 1.9 | 1.9 |
| 12 | 1.95 | 2.0 | 2.0 | 2.0 | 2.0 | 2.55 | 2.45 | 1.9 | 2.0 | 2.0 | 1.9 | 1.9 |
| 13 | 1.95 | 2.0 | 2.5 | 2.0 | 2.0 | 2.7 | 2.4 | 1.9 | 2.0 | 2.0 | 1.9 | 1.9 |
| 14 | 1.9 | 2.0 | 2.15 | 1.95 | 2.0 | 2.75 | 2.4 | 2.0 | 2.0 | 2.0 | 1.95 | 1.85 |
| 15 | 1.9 | 2.0 | 2.15 | 1.9 | 2.0 | 2.75 | 2.4 | 2.0 | 2.0 | 2.0 | 2.0 | 1.85 |
| 16 | 1.9 | 2.0 | 2.15 | 1.9 | 2.0 | 2.75 | 2.3 | 2.0 | 2.0 | 2.0 | 2.0 | 1.85 |
| 17 | 1.95 | 2.0 | 2.1 | 1.95 | 2.2 | 3.0 | 2.2 | 1.9 | 2.0 | 1.95 | 2.0 | 1.8 |
| 18 | 1.95 | 2.1 | 2.1 | 1.95 | 2.35 | 3.0 | 2.2 | 1.9 | 2.0 | 1.95 | 2.0 | 1.8 |
| 19 | 2.0 | 2.2 | 2.05 | 1.95 | 2.35 | 3.0 | 2.2 | 1.9 | 2.0 | 1.9 | 2.0 | 1.8 |
| 20 | 2.0 | 2.1 | 2.05 | 1.95 | 2.4 | 3.0 | 2.2 | 1.85 | 2.0 | 1.85 | 2.0 | 1.75 |
| 21 | 2.1 | 2.0 | 2.1 | 1.9 | 2.4 | 3.0 | 2.15 | 1.85 | 2.0 | 1.85 | 2.0 | 1.75 |
| 22 | 2.1 | 1.95 | 2.1 | 1.9 | 2.4 | 3.0 | 2.1 | 1.9 | 2.0 | 1.85 | 2.0 | 1.75 |
| 23 | 2.0 | 1.95 | 2.1 | 1.9 | 2.4 | 3.0 | 2.1 | 1.9 | 2.0 | 1.85 | 2.0 | 1.75 |
| 24 | 2.0 | 1.9 | 2.0 | 1.95 | 2.4 | 2.95 | 2.1 | 1.9 | 2.0 | 1.85 | 2.0 | 1.75 |
| 25 | 2.1 | 1.85 | 2.0 | 1.95 | 2.4 | 2.8 | 2.1 | 1.9 | 2.0 | 1.8 | 2.0 | 1.75 |
| 26 | 2.1 | 1.85 | 2.0 | 1.95 | 2.4 | 2.7 | 2.0 | 1.9 | 2.0 | 1.8 | 2.0 | 1.8 |
| 27 | 2.1 | 2.0 | 2.0 | 1.95 | 2.45 | 2.6 | 2.0 | 1.9 | 2.0 | 1.75 | 2.0 | 1.8 |
| 28 | 2.1 | 2.1 | 1.95 | 2.0 | 2.55 | 2.6 | 2.0 | 1.9 | 2.0 | 1.75 | 1.95 | 1.8 |
| 29 | 2.1 | ....... | 1.9 | 2.05 | 2.5 | 2.55 | 2.0 | 1.9 | 2.0 | 1.75 | 1.9 | 1.8 |
| 30 | 2.2 | ....... | 1.9 | 2.05 | 2.4 | 2.5 | 2.0 | 1.9 | 2.0 | 1.75 | 1.9 | 1.8 |
| 31 | 2.2 | ....... | 1.9 | ....... | 2.3 | ....... | 2.0 | 1.9 | ....... | 1.75 | ....... | 1.8 |

*Station rating table for Owens River near Round Valley, Cal., from January 1 to October 10, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 134 | 2.20 | 240 | 2.60 | 377 | 3.00 | 533 |
| 1.90 | 158 | 2.30 | 271 | 2.70 | 415 | | |
| 2.00 | 184 | 2.40 | 304 | 2.80 | 453 | | |
| 2.10 | 211 | 2.50 | 339 | 2.90 | 493 | | |

NOTE.—The above table is based on 12 discharge measurements made during 1904-5. It is fairly well defined between gage heights 1.9 feet and 3.1 feet.

*Station rating table for Owens River near Round Valley, Cal., from October 11 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 141 | 1.80 | 165 | 1.90 | 191 | 2.00 | 219 |

NOTE.—The above table is based on three discharge measurements made during the latter part of 1905 and is fairly well defined.

*Estimated monthly discharge of Owens River near Round Valley, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 240 | 158 | 193 | 11,870 |
| February | 240 | 146 | 196 | 10,880 |
| March | 339 | 158 | 213 | 13,100 |
| April | 211 | 158 | 177 | 10,530 |
| May | 358 | 184 | 246 | 15,130 |
| June | 533 | 271 | 392 | 23,330 |
| July | 377 | 184 | 275 | 16,910 |
| August | 211 | 146 | 169 | 10,390 |
| September | 184 | 158 | 180 | 10,710 |
| October | 219 | 153 | 180 | 11,070 |
| November | 219 | 153 | 197 | 11,720 |
| December | 219 | 153 | 179 | 11,010 |
| The year | 533 | 146 | 216 | 156,600 |

### ROCK CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the wagon bridge on the road from Long Valley to Bishop 3,500 feet above the mouth of the creek.

The channel is straight for 50 feet above and 40 feet below the footbridge. The current is swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made from a footbridge, which has a span of 18 feet. The initial point for soundings is on right bank of stream.

The gage is a vertical rod fastened to the left end of the bridge. During 1905 the gage was read once each day by T. E. Jones The bench mark is a point marked on a lava rock 15 feet east of the left end of the footbridge.

Information in regard to this station is contained in the following water-supply papers of the United States Geological Survey:

Description: 100, p 207; 134, p 204.
Discharge: 100, p 207; 134, p 204.
Discharge, monthly: 134, p 207.
Gage heights: 100, p 208; 134, pp 205–206.
Rating table: 134 p 206.

*Discharge measurements of Rock Creek near Round Valley, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 16 | R. J. Taylor | 13 | 16 | 1.76 | 1.52 | 28 |
| February 9 | do | 13 | 12.8 | 1.56 | 1.30 | 20 |
| April 4 | J. S. Evans | 13 | 12.8 | 1.55 | 1.40 | 19.9 |
| April 25 | do | 12 | 11.6 | 1.60 | 1.15 | 18.6 |
| May 24 | do | 14 | 19.3 | 2.02 | 1.80 | 39 |
| June 27 | do | 14.5 | 23 | 2.22 | 2.00 | 51 |
| July 25 | do | 13 | 12.6 | 1.90 | 1.30 | 24 |
| August 15 | do | 12.5 | 11.6 | 1.69 | 1.20 | 19.6 |
| September 8 | do | 12 | 11.2 | 1.57 | 1.18 | 18.6 |
| September 27 | do | 12 | 11.6 | 1.57 | 1.20 | 18.2 |
| November 2 | F. R. S. Buttemer | 13.5 | 14 | 1.50 | 1.35 | 21 |
| November 24 | do | 13.5 | 15.3 | 1.50 | 1.46 | 23 |
| December 10 | do | 13.5 | 16 | 1.69 | 1.60 | 27 |

*Daily gage height, in feet, of Rock Creek near Round Valley, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 2.1 | 1.4 | 1.4 | 1.3 | 1.7 | 1.8 | 1.35 | 1.2 | 1.2 | 1.3 | 1.6 |
| 2 | 1.6 | 1.6 | 1.4 | 1.4 | 1.4 | 1.65 | 1.8 | 1.35 | 1.2 | 1.2 | 1.3 | 1.6 |
| 3 | 1.6 | 1.6 | 1.4 | 1.4 | 1.35 | 1.65 | 1.75 | 1.35 | 1.2 | 1.2 | 1.3 | 1.65 |
| 4 | 1.5 | 1.5 | 1.4 | 1.4 | 1.3 | 1.6 | 1.75 | 1.3 | 1.2 | 1.25 | 1.3 | 1.65 |
| 5 | 1.5 | 1.5 | 1.35 | 1.4 | 1.3 | 1.6 | 1.8 | 1.3 | 1.2 | 1.25 | 1.3 | 1.65 |
| 6 | 1.5 | 1.5 | 1.3 | 1.4 | 1.2 | 1.6 | 1.8 | 1.25 | 1.2 | 1.25 | 1.3 | 1.65 |
| 7 | 1.5 | 1.4 | 1.2 | 1.4 | 1.2 | 1.5 | 1.9 | 1.3 | 1.2 | 1.25 | 1.3 | 1.65 |
| 8 | 1.5 | 1.35 | 1.2 | 1.4 | 1.2 | 1.6 | 2.0 | 1.3 | 1.2 | 1.25 | 1.25 | 1.65 |
| 9 | 1.4 | 1.3 | 1.1 | 1.3 | 1.25 | 1.7 | 2.0 | 1.4 | 1.2 | 1.25 | 1.25 | 1.65 |
| 10 | 1.3 | 1.3 | 1.1 | 1.3 | 1.25 | 1.7 | 2.0 | 1.4 | 1.2 | 1.25 | 1.25 | 1.6 |
| 11 | 1.3 | 1.3 | 1.2 | 1.25 | 1.25 | 1.8 | 2.0 | 1.3 | 1.2 | 1.2 | 1.2 | 1.6 |
| 12 | 1.3 | 1.4 | 1.2 | 1.25 | 1.3 | 2.1 | 2.0 | 1.25 | 1.2 | 1.2 | 1.2 | 1.6 |
| 13 | 1.3 | 1.4 | 1.5 | 1.25 | 1.3 | 2.1 | 2.0 | 1.25 | 1.2 | 1.2 | 1.25 | 1.6 |
| 14 | 1.3 | 1.4 | 1.35 | 1.2 | 1.3 | 2.15 | 2.0 | 1.2 | 1.15 | 1.2 | 1.3 | 1.6 |
| 15 | 1.3 | 1.4 | 1.35 | 1.2 | 1.3 | 2.3 | 2.0 | 1.2 | 1.1 | 1.25 | 1.3 | 1.6 |
| 16 | 1.35 | 1.45 | 1.4 | 1.2 | 1.3 | 2.3 | 1.9 | 1.15 | 1.1 | 1.25 | 1.3 | 1.6 |
| 17 | 1.4 | 1.5 | 1.45 | 1.15 | 1.7 | 2.35 | 1.8 | 1.15 | 1.15 | 1.3 | 1.3 | 1.6 |
| 18 | 1.4 | 1.4 | 1.45 | 1.1 | 1.9 | 2.4 | 1.7 | 1.15 | 1.15 | 1.3 | 1.3 | 1.6 |
| 19 | 1.45 | 1.4 | 1.4 | 1.1 | 1.9 | 2.5 | 1.6 | 1.15 | 1.2 | 1.3 | 1.3 | 1.6 |
| 20 | 1.45 | 1.4 | 1.4 | 1.0 | 1.9 | 2.45 | 1.6 | 1.15 | 1.2 | 1.3 | 1.3 | 1.6 |
| 21 | 1.7 | 1.4 | 1.35 | 1.0 | 1.8 | 2.4 | 1.6 | 1.15 | 1.25 | 1.3 | 1.3 | 1.55 |
| 22 | 1.7 | 1.4 | 1.35 | 1.0 | 1.8 | 2.3 | 1.55 | 1.15 | 1.3 | 1.3 | 1.35 | 1.55 |
| 23 | 1.6 | 1.4 | 1.3 | 1.0 | 1.75 | 2.3 | 1.55 | 1.15 | 1.3 | 1.3 | 1.4 | 1.55 |
| 24 | 1.6 | 1.45 | 1.35 | 1.1 | 1.75 | 2.2 | 1.5 | 1.1 | 1.3 | 1.3 | 1.45 | 1.5 |
| 25 | 1.5 | 1.45 | 1.4 | 1.15 | 1.7 | 2.2 | 1.5 | 1.1 | 1.3 | 1.3 | 1.5 | 1.5 |
| 26 | 1.4 | 1.45 | 1.4 | 1.15 | 1.7 | 2.1 | 1.4 | 1.1 | 1.25 | 1.3 | 1.5 | 1.55 |
| 27 | 1.4 | 1.4 | 1.4 | 1.15 | 1.75 | 2.0 | 1.4 | 1.1 | 1.2 | 1.25 | 1.55 | 1.6 |
| 28 | 1.4 | 1.4 | 1.4 | 1.2 | 1.9 | 1.9 | 1.3 | 1.1 | 1.2 | 1.25 | 1.6 | 1.6 |
| 29 | 1.4 | ....... | 1.4 | 1.2 | 1.8 | 1.85 | 1.25 | 1.1 | 1.2 | 1.25 | 1.6 | 1.6 |
| 30 | 1.3 | ....... | 1.4 | 1.25 | 1.8 | 1.8 | 1.25 | 1.15 | 1.2 | 1.25 | 1.55 | 1.6 |
| 31 | 1.3 | ....... | 1.4 | ....... | 1.75 | ....... | 1.4 | 1.15 | ....... | 1.25 | ....... | 1.55 |

*Daily discharge, in second-feet, of Rock Creek near Round Valley, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 34 | 56 | 23 | 23 | 20 | 34 | 42 | 24 | 19 | 19 | 20 | 27 |
| 2 | 30 | 30 | 23 | 23 | 23 | 32 | 42 | 24 | 19 | 19 | 20 | 27 |
| 3 | 30 | 30 | 23 | 23 | 21 | 32 | 40 | 24 | 19 | 19 | 20 | 28 |
| 4 | 26 | 26 | 23 | 23 | 20 | 30 | 40 | 23 | 19 | 19 | 20 | 28 |
| 5 | 26 | 26 | 21 | 23 | 20 | 30 | 42 | 23 | 19 | 19 | 20 | 28 |
| 6 | 26 | 26 | 20 | 23 | 18 | 30 | 42 | 21 | 19 | 19 | 20 | 28 |
| 7 | 26 | 23 | 18 | 23 | 18 | 26 | 46 | 23 | 19 | 19 | 20 | 28 |
| 8 | 26 | 21 | 18 | 23 | 18 | 30 | 51 | 23 | 19 | 19 | 19 | 28 |
| 9 | 23 | 20 | 16 | 20 | 19 | 34 | 51 | 26 | 19 | 19 | 19 | 28 |
| 10 | 20 | 20 | 16 | 20 | 19 | 34 | 51 | 26 | 19 | 19 | 19 | 27 |
| 11 | 20 | 20 | 18 | 19 | 19 | 39 | 51 | 23 | 19 | 19 | 19 | 27 |
| 12 | 20 | 23 | 18 | 19 | 20 | 56 | 51 | 21 | 19 | 19 | 19 | 27 |
| 13 | 20 | 23 | 26 | 19 | 20 | 56 | 51 | 21 | 19 | 19 | 19 | 27 |
| 14 | 20 | 23 | 21 | 18 | 20 | 59 | 51 | 20 | 18 | 19 | 20 | 27 |
| 15 | 20 | 23 | 21 | 18 | 20 | 68 | 51 | 20 | 18 | 19 | 20 | 27 |
| 16 | 21 | 24 | 23 | 18 | 20 | 68 | 46 | 18 | 18 | 19 | 20 | 27 |
| 17 | 23 | 26 | 24 | 17 | 34 | 71 | 42 | 18 | 18 | 20 | 20 | 27 |
| 18 | 23 | 23 | 24 | 16 | 44 | 74 | 38 | 18 | 18 | 20 | 20 | 27 |
| 19 | 24 | 23 | 23 | 16 | 44 | 81 | 33 | 18 | 19 | 20 | 20 | 27 |
| 20 | 24 | 23 | 23 | 14 | 44 | 78 | 33 | 18 | 19 | 20 | 20 | 27 |
| 21 | 34 | 23 | 21 | 14 | 39 | 74 | 33 | 18 | 19 | 20 | 20 | 26 |
| 22 | 34 | 23 | 21 | 14 | 39 | 68 | 31 | 18 | 20 | 20 | 21 | 26 |
| 23 | 30 | 23 | 20 | 14 | 36 | 68 | 31 | 18 | 20 | 20 | 22 | 26 |
| 24 | 30 | 24 | 21 | 16 | 36 | 62 | 30 | 17 | 20 | 20 | 23 | 24 |
| 25 | 26 | 24 | 23 | 17 | 34 | 62 | 30 | 17 | 20 | 20 | 24 | 24 |
| 26 | 23 | 24 | 23 | 17 | 34 | 56 | 26 | 17 | 19 | 20 | 24 | 26 |
| 27 | 23 | 23 | 23 | 17 | 36 | 50 | 26 | 17 | 19 | 19 | 26 | 27 |
| 28 | 23 | 23 | 23 | 18 | 44 | 46 | 23 | 17 | 19 | 19 | 27 | 27 |
| 29 | 23 | ....... | 23 | 18 | 39 | 44 | 21 | 17 | 19 | 19 | 27 | 27 |
| 30 | 20 | ....... | 23 | 19 | 39 | 42 | 21 | 18 | 19 | 19 | 26 | 27 |
| 31 | 20 | ....... | 23 | ....... | 36 | ....... | 26 | 18 | ....... | 19 | ....... | 26 |

NOTE.—Owing to shifting conditions, the daily discharge has been computed from several curves, each covering a short period of time.

*Estimated monthly discharge of Rock Creek near Round Valley, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 34 | 20 | 24.8 | 1,525 |
| February | 56 | 20 | 24.9 | 1,383 |
| March | 26 | 16 | 21.5 | 1,322 |
| April | 23 | 14 | 18.7 | 1,113 |
| May | 44 | 18 | 28.8 | 1,771 |
| June | 81 | 26 | 51.1 | 3,041 |
| July | 51 | 21 | 38.5 | 2,367 |
| August | 26 | 17 | 20.1 | 1,236 |
| September | 20 | 18 | 19.0 | 1,131 |
| October | 20 | 19 | 19.3 | 1,187 |
| November | 27 | 19 | 21.1 | 1,256 |
| December | 28 | 24 | 26.9 | 1,654 |
| The year | 81 | 14 | 26.2 | 18,990 |

### PINE CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located 150 feet below the wagon bridge on the road from Bishop to Long Valley and 100 feet above the mouth of the creek.

The channel is straight for about 50 feet above and 100 feet below the station. The current has a velocity of about 1 foot per second at ordinary stages. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rocky and permanent.

Discharge measurements are made by wading. The initial point for soundings is a stake on the right bank of the stream.

The gage is a vertical rod fastened in the rocks near the right bank. During 1905 the gage was read once each day by T. E. Jones. The bench mark is the one at the Rock Creek station. It is a point marked on the lava rock 15 feet east of the left end of the footbridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 208; 134, p 207.
Discharge: 100, p 209; 134, p 208.
Discharge, monthly: 134, p 210.
Gage heights: 100, p 209; 134, pp 208-209.
Rating table: 134, p 210.

*Discharge measurements of Pine Creek near Round Valley, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 16 | R. J. Taylor | 20 | 15.2 | 0.88 | 1.91 | 13.3 |
| February 9 | do | 20 | 15.2 | .67 | 1.86 | 10.2 |
| April 4 | J. S. Evans | 8 | 10.4 | .19 | 1.80 | 2.0 |
| April 25 | do | 10 | 8.8 | .66 | 1.70 | 5.8 |
| June 27 | do | 27 | 2.8 | 2.61 | 2.90 | 73 |
| July 25 | do | 19 | 16.1 | 1.43 | 2.05 | 23 |
| August 15 | do | 18 | 10.8 | .67 | 1.80 | 7.2 |
| September 8 | do | 17 | 9.2 | .73 | 1.75 | 6.7 |
| September 27 | do | 17 | 8.1 | .77 | 1.78 | 6.2 |
| November 2 | F. R. S. Buttemer | 17 | 19.7 | .44 | 1.83 | 8.7 |
| November 24 | do | 18 | 18.2 | .42 | 1.85 | 7.7 |
| December 10 | do | 18 | 18.4 | .41 | 1.82 | 7.6 |

*Daily gage height, in feet, of Pine Creek near Round Valley, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.2 | 2.2 | 1.8 | 1.8 | 1.8 | 1.9 | 2.9 | 1.8 | 1.7 | 1.8 | 1.8 | 1.85 |
| 2 | 2.15 | 2.0 | 1.8 | 1.8 | 1.8 | 1.9 | 2.9 | 1.7 | 1.7 | 1.8 | 1.8 | 1.85 |
| 3 | 2.1 | 2.0 | 1.8 | 1.8 | 1.75 | 1.9 | 2.85 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 |
| 4 | 1.95 | 1.9 | 1.8 | 1.8 | 1.75 | 1.9 | 2.8 | 1.7 | 1.7 | 1.85 | 1.8 | 1.9 |
| 5 | 1.95 | 1.9 | 1.8 | 1.8 | 1.75 | 1.95 | 2.8 | 1.7 | 1.7 | 1.85 | 1.85 | 1.9 |
| 6 | 1.95 | 1.8 | 1.8 | 1.8 | 1.7 | 1.95 | 2.8 | 1.7 | 1.7 | 1.85 | 1.85 | 1.9 |
| 7 | 1.9 | 1.8 | 1.8 | 1.75 | 1.7 | 2.05 | 2.9 | 1.7 | 1.7 | 1.85 | 1.85 | 1.9 |
| 8 | 1.9 | 1.85 | 1.8 | 1.75 | 1.7 | 2.1 | 2.95 | 1.7 | 1.65 | 1.85 | 1.85 | 1.9 |
| 9 | 1.9 | 1.85 | 1.8 | 1.75 | 1.7 | 2.45 | 3.0 | 1.8 | 1.6 | 1.85 | 1.8 | 1.9 |
| 10 | 1.8 | 1.85 | 1.75 | 1.75 | 1.7 | 2.7 | 3.0 | 1.8 | 1.65 | 1.8 | 1.8 | 1.85 |
| 11 | 1.8 | 1.85 | 1.75 | 1.8 | 1.75 | 2.6 | 2.9 | 1.75 | 1.65 | 1.8 | 1.8 | 1.85 |
| 12 | 1.8 | 1.85 | 1.8 | 1.8 | 1.8 | 2.8 | 2.85 | 1.7 | 1.65 | 1.7 | 1.8 | 1.85 |
| 13 | 1.75 | 1.85 | 1.8 | 1.8 | 1.8 | 3.3 | 2.8 | 1.7 | 1.65 | 1.75 | 1.8 | 1.8 |
| 14 | 1.75 | 1.85 | 1.8 | 1.8 | 1.8 | 3.3 | 2.7 | 1.7 | 1.65 | 1.75 | 1.8 | 1.8 |
| 15 | 1.75 | 1.85 | 1.8 | 1.8 | 1.75 | 3.3 | 2.6 | 1.7 | 1.6 | 1.8 | 1.8 | 1.8 |
| 16 | 1.8 | 1.8 | 1.85 | 1.8 | 1.75 | 3.3 | 2.5 | 1.7 | 1.6 | 1.8 | 1.8 | 1.8 |
| 17 | 1.8 | 1.8 | 1.85 | 1.8 | 1.75 | 3.25 | 2.4 | 1.7 | 1.65 | 1.8 | 1.8 | 1.8 |
| 18 | 1.8 | 1.85 | 1.85 | 1.75 | 1.75 | 3.2 | 2.45 | 1.75 | 1.65 | 1.85 | 1.8 | 1.8 |
| 19 | 1.8 | 1.85 | 1.8 | 1.75 | 1.75 | 3.2 | 2.5 | 1.75 | 1.7 | 1.85 | 1.8 | 1.8 |
| 20 | 1.85 | 1.8 | 1.8 | 1.75 | 1.8 | 3.1 | 2.5 | 1.75 | 1.7 | 1.85 | 1.8 | 1.8 |
| 21 | 2.0 | 1.8 | 1.8 | 1.75 | 1.9 | 3.1 | 2.1 | 1.75 | 1.75 | 1.85 | 1.8 | 1.8 |
| 22 | 2.0 | 1.8 | 1.8 | 1.7 | 1.9 | 3.1 | 1.95 | 1.75 | 1.8 | 1.85 | 1.8 | 1.8 |
| 23 | 1.9 | 1.8 | 1.8 | 1.7 | 1.9 | 3.0 | 1.95 | 1.75 | 1.8 | 1.85 | 1.8 | 1.8 |
| 24 | 1.9 | 1.8 | 1.8 | 1.7 | 2.0 | 2.9 | 2.0 | 1.7 | 1.8 | 1.85 | 1.85 | 1.8 |
| 25 | 1.9 | 1.85 | 1.8 | 1.7 | 2.0 | 2.9 | 2.0 | 1.7 | 1.8 | 1.85 | 1.85 | 1.8 |
| 26 | 1.9 | 1.85 | 1.8 | 1.7 | 2.0 | 2.9 | 2.0 | 1.7 | 1.8 | 1.85 | 1.85 | 1.8 |
| 27 | 1.9 | 1.8 | 1.8 | 1.7 | 2.0 | 2.9 | 2.05 | 1.7 | 1.8 | 1.8 | 1.85 | 1.8 |
| 28 | 1.9 | 1.8 | 1.75 | 1.75 | 1.95 | 2.9 | 2.05 | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 |
| 29 | 1.9 | ....... | 1.75 | 1.75 | 1.9 | 2.9 | 2.0 | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 |
| 30 | 1.85 | ....... | 1.75 | 1.75 | 1.8 | 2.9 | 2.0 | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 |
| 31 | 1.85 | ....... | 1.8 | ....... | 1.85 | ....... | 1.9 | 1.7 | ....... | 1.8 | ....... | 1.8 |

*Station rating table for Pine Creek near Round Valley, Cal., from August 4, 1903, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 1 | 2.10 | 23 | 2.60 | 52 | 3.10 | 95 |
| 1.70 | 4 | 2.20 | 28 | 2.70 | 59 | 3.20 | 106 |
| 1.80 | 8 | 2.30 | 33 | 2.80 | 67 | 3.30 | 119 |
| 1.90 | 13 | 2.40 | 39 | 2.90 | 75 | | |
| 2.00 | 18 | 2.50 | 45 | 3.00 | 85 | | |

NOTE.—The above table is based on 20 discharge measurements made during 1903-1905. It is fairly well defined between gage heights 1.7 feet and 3 feet. The table has been extended beyond these limits, being based on one measurement at 3.7 feet.

*Estimated monthly discharge of Pine Creek near Round Valley, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 28 | 6 | 12.7 | 781 |
| February | 28 | 8 | 10.6 | 589 |
| March | 10 | 6 | 7.9 | 486 |
| April | 8 | 4 | 6.5 | 387 |
| May | 18 | 4 | 9.0 | 553 |
| June | 119 | 13 | 68.1 | 4,052 |
| July | 85 | 13 | 47.9 | 2,945 |
| August | 8 | 4 | 4.8 | 295 |
| September | 8 | 1 | 4.6 | 274 |
| October | 10 | 4 | 8.7 | 535 |
| November | 10 | 8 | 8.5 | 506 |
| December | 13 | 8 | 9.5 | 584 |
| The year | 119 | 1 | 16.6 | 11,990 |

### OWENS RIVER CANAL NEAR BISHOP, CAL.

This station was established August 5, 1903, by J. C. Clausen and R. S. Hawley. It is located at the footbridge near the quarter-section line which divides the north half of sec. 27, T 6 S.., R. 32 E., of the Mount Diablo meridian.

The channel is straight for 300 feet above and 100 feet below the station. The current is sluggish. The right bank is high and rocky and will not overflow. The left bank is low and will overflow. The bed of the stream is composed of gravel and is permanent.

Discharge measurements are made from the footbridge. The initial point for soundings is on right bank of the canal.

The gage is a vertical rod nailed to the bridge. No regular observer could be obtained, but the ditch tender reads the rod when passing the station.

Information in regard to this station is contained in the following Water-Supply Paper of the United States Geological Survey:

Description: 100, pp 209-210; 134, p 211.
Discharge: 100, p 210; 134, p 211.
Discharge, monthly: 134, p 213.
Gage heights: 100, p 210; 134, p 212.
Rating table: 134, p 213.

*Discharge measurements of Owens River Canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 10 | R. J. Taylor | 11.5 | 4.9 | 0.92 | 1.55 | 4.5 |
| February 4 | do | 11 | 4.1 | .80 | 1.49 | 3.3 |
| April 6 | J. S. Evans | 14.5 | 16.4 | 1.71 | 2.40 | 28 |
| April 24 | do | 15.0 | 22 | 1.91 | 2.77 | 42 |
| May 12 | do | 14.5 | 24 | 1.79 | 2.78 | 43 |
| June 1 | do | 14.5 | 21 | 1.76 | 2.62 | 38 |
| July 7 | do | 14 | 16.8 | 1.90 | 2.30 | 32 |
| August 4 | do | 14.5 | 23 | 1.87 | 2.75 | 43 |
| September 11 | do | 15 | 19.6 | 1.73 | 2.60 | 34 |
| October 24 | F. R. S. Buttemer | 14.5 | 19.3 | 1.45 | 2.38 | 28 |
| November 22 | do | 12 | 5.6 | .95 | 1.50 | 5.3 |
| December 13 | do | 13 | 6.6 | 1.17 | 1.63 | 7.7 |

*Daily gage height, in feet, of Owens River canal near Bishop, Cal., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|
| 1 | ........ | 0.0 | 2.7 | 2.55 | 2.8 | 2.55 | 2.8 |
| 2 | ........ | .0 | 2.7 | 2.55 | 2.75 | 2.55 | 2.8 |
| 3 | ........ | .0 | 2.7 | 2.55 | 2.8 | 2.55 | 2.8 |
| 4 | ........ | 2.4 | ........ | 2.55 | 2.75 | 2.55 | 2.8 |
| 5 | ........ | 2.7 | 2.65 | 2.55 | 2.8 | 2.55 | 2.8 |
| 6 | ........ | 2.7 | 2.65 | 2.55 | 2.85 | 2.75 | 2.75 |
| 7 | ........ | 2.7 | 2.6 | 2.55 | 2.9 | 2.8 | 2.75 |
| 8 | ........ | 2.65 | 2.6 | 2.55 | 2.85 | 2.8 | 2.8 |
| 9 | ........ | 2.7 | ........ | 2.55 | 2.85 | 2.8 | 2.8 |
| 10 | ........ | 2.5 | ........ | 2.55 | 2.9 | 2.8 | 2.8 |
| 11 | ........ | 2.7 | 2.65 | 2.55 | 2.9 | 2.75 | 2.7 |
| 12 | ........ | 2.8 | 2.7 | 2.55 | 2.5 | 2.8 | 2.7 |
| 13 | ........ | 2.8 | 2.65 | 2.55 | 2.5 | 2.8 | 2.7 |
| 14 | ........ | ........ | 2.7 | 2.55 | 2.5 | 2.8 | 2.75 |
| 15 | ........ | 2.75 | 2.55 | 2.55 | 2.5 | 2.75 | ........ |
| 16 | ........ | 2.8 | 2.55 | 2.55 | 2.5 | 2.8 | ........ |
| 17 | ........ | 2.75 | 2.55 | 2.5 | .0 | 2.75 | ........ |
| 18 | ........ | 2.75 | 2.55 | 2.65 | .0 | 2.6 | ........ |
| 19 | ........ | 2.7 | 2.5 | 2.7 | .0 | 2.6 | ........ |
| 20 | ........ | 2.75 | 2.5 | 2.7 | 2.6 | 2.6 | ........ |
| 21 | ........ | 2.75 | 2.5 | 2.65 | 2.6 | 2.6 | ........ |
| 22 | ........ | 2.7 | 2.55 | 2.65 | .0 | 2.6 | ........ |
| 23 | ........ | 2.65 | 2.55 | 2.7 | .0 | 2.6 | ........ |
| 24 | ........ | 2.65 | 2.55 | 2.7 | 2.6 | 2.6 | ........ |
| 25 | ........ | 2.7 | 2.55 | 2.7 | 2.6 | 2.65 | ........ |
| 26 | 2.8 | 2.7 | 2.55 | 2.7 | 2.8 | 2.65 | ........ |
| 27 | 2.8 | 2.75 | 2.55 | 2.7 | 2.85 | 2.7 | ........ |
| 28 | ........ | ........ | 2.55 | 2.75 | 2.85 | 2.65 | ........ |
| 29 | ........ | ........ | 2.55 | 2.7 | 2.9 | 2.5 | ........ |
| 30 | 2.65 | 2.7 | 2.55 | 2.8 | 2.95 | 2.8 | ........ |
| 31 | | 2.7 | ........ | 2.75 | 2.55 | ........ | ........ |

### BISHOP CREEK CANAL NEAR BISHOP, CAL.

This station was established August 5, 1903, by J. C. Clausen, assisted by R. S. Hawley. It is located at the footbridge below the waste gate near the house of A. Fitzgerald, 3½ miles northwest of Bishop, Cal.

The channel is straight for 50 feet above and 100 feet below this station. The current is swift. The right bank is high and the left bank is low. Neither bank is liable to overflow. The bed of the stream is composed of sand and gravel and is fairly permanent.

Discharge measurements are made from the footbridge. The initial point for soundings is on right bank.

The gage is a vertical rod fastened to the bridge anchor.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 210–211; 134, p 214.
Discharge: 100, p 211; 134, p 214.
Discharge, monthly: 134, p 216.
Gage heights: 100, p 211; 134, p 215.
Rating table: 134, p 216.

*Discharge measurements of Bishop Creek canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 17 | R. J. Taylor | 15 | 10.1 | 0.84 | 1.40 | 8.5 |
| April 6 | J. S. Evans | 16 | 30 | 2.07 | 2.80 | 62 |
| April 24 | do | 16 | 47 | 2.23 | 3.81 | 105 |
| May 12 | do | 16 | 49 | 2.20 | 3.95 | 108 |
| June 1 | do | 16 | 50 | 2.08 | 4.00 | 105 |
| July 7 | do | 16 | 44 | 1.75 | 3.70 | 77 |
| August 4 | do | 16 | 51 | 2.39 | 4.10 | 122 |
| September 11 | do | 16 | 44 | 2.20 | 3.85 | 97 |
| October 24 | F. R. S. Buttemer | 16 | 26 | 1.12 | 1.92 | 29 |
| November 22 | do | 13 | 4.6 | .39 | 1.05 | 1.8 |
| December 13 | do | 13 | 5.1 | .31 | 1.06 | 1.6 |
| December 21 | do | 14 | 15.6 | .79 | 1.21 | 12.4 |

*Daily gage height, in feet, of Bishop Creek canal near Bishop, Cal., for 1905.*

| Day. | Aug. | Sept. | Day. | Aug. | Sept. | Day. | Aug. | Sept. | Day. | Aug. | Sept |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 9 | 3.9 | 3.5 | 17 | 3.5 | 2.9 | 25 | 4.0 | |
| 2 | | | 10 | 3.5 | 3.5 | 18 | 3.5 | 2.9 | 26 | 4.0 | |
| 3 | | 4.0 | 11 | 3.5 | 3.5 | 19 | 3.5 | 2.9 | 27 | | |
| 4 | | 4.0 | 12 | 3.5 | 3.5 | 20 | 3.5 | 2.9 | 28 | | |
| 5 | | 4.0 | 13 | 3.5 | 3.5 | 21 | | 2.9 | 29 | | |
| 6 | 3.9 | 3.5 | 14 | 3.5 | 3.5 | 22 | 3.5 | 2.9 | 30 | | |
| 7 | 3.9 | 3.5 | 15 | 3.5 | 3.5 | 23 | | 2.9 | 31 | | |
| 8 | 3.9 | 3.5 | 16 | 3.5 | 3.5 | 24 | 3.5 | | | | |

### FARMERS' CANAL NEAR BISHOP, CAL.

This station was established August 6, 1903, by J. C. Clausen and R. S. Hawley. It is located at the footbridge near the house of Robert Love and 3 miles north of Bishop, Cal.

The channel is straight for 300 feet above and 50 feet below the station. The current is sluggish. Both banks are low and are liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the footbridge, to which the gage is attached. The initial point for soundings is on the footbridge, near the right bank.

The gage is a vertical rod fastened to the bridge pier.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 211-212; 134, p 216.
Discharge: 100, p 212; 134, p 217.
Discharge, monthly: 134, p 219.
Gage heights: 100, p 212; 134, pp 217-218.
Rating table: 134, p 219.

*Discharge measurements of Farmers' canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 10 | R. J. Taylor | 13 | 9.0 | 0.69 | 2.20 | 6.2 |
| February 4 | do | 13 | 9.4 | .74 | 2.16 | 7.0 |
| March 7 | do | 10 | 16.8 | 1.79 | 2.90 | 30 |
| April 6 | J. S. Evans | 10.5 | 12.8 | 1.47 | 2.55 | 18.8 |
| April 24 | do | 10 | 8.4 | .64 | 2.30 | 5.4 |
| May 12 | do | 10.5 | 12.8 | 1.16 | 2.60 | 14.9 |
| June 1 | do | 10.5 | 14.6 | 1.37 | 2.60 | 20 |
| July 7 | do | 9.5 | 15.4 | 1.56 | 2.75 | 24 |
| August 4 | do | 10 | 9.0 | .53 | 2.00 | 4.8 |
| September 11 | do | 10.5 | 15.7 | 1.04 | 2.55 | 16.4 |
| November 22 | F. R. S. Buttemer | 10.5 | 10.8 | .70 | 2.35 | 7.6 |
| December 13 | do | 10.5 | 10.8 | .59 | 2.36 | 6.4 |

*Daily gage height, in feet, of Farmers' canal near Bishop, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | 2.5 |
| 2 | | | | | 2.8 | 2.7 | | |
| 3 | 2.2 | 2.15 | 3.0 | | | | 2.6 | |
| 4 | | 2.16 | | 2.65 | | | | 2.5 |
| 5 | | | 2.9 | | 2.8 | | | |
| 6 | 2.2 | | | 2.55 | | 2.7 | | |
| 7 | | | 2.9 | | | | 2.75 | |
| 8 | | | | | | | | 2.6 |
| 9 | 2.2 | | 2.9 | | 2.6 | 2.75 | | |
| 10 | 2.2 | | | | | | | |
| 11 | | 2.15 | | 1.8 | | | | 2.6 |
| 12 | | | | | 2.6 | | 2.7 | |
| 13 | | | | | 2.6 | 2.9 | | |
| 14 | 2.2 | 2.15 | 3.0 | 1.7 | | | 2.65 | |
| 15 | | | | | | | | 2.65 |
| 16 | | | | | 2.65 | 2.95 | | |
| 17 | 2.15 | | 2.9 | | | | | |
| 18 | | | | 1.1 | | | 2.6 | 2.55 |
| 19 | | | | | 2.95 | | | |
| 20 | 2.15 | | | | | 2.8 | | |
| 21 | | | | | | | 2.6 | 2.2 |
| 22 | | | | 1.2 | | | | |
| 23 | | | 2.75 | | 2.95 | 2.7 | | |
| 24 | | | | 2.3 | | | | |
| 25 | 2.15 | | | 2.3 | | | 2.6 | 2.65 |
| 26 | | | | | 2.9 | | | 2.65 |
| 27 | | | | | | 2.7 | | |
| 28 | 2.15 | | 2.75 | 2.7 | | | 2.55 | |
| 29 | | | | | | | | |
| 30 | | | | | 2.9 | 2.6 | | |
| 31 | 2.15 | | 2.75 | | | | | |

### McNALLY CANAL NEAR BISHOP, CAL.

This station was established July 31, 1903, by J. C. Clausen and R. S. Hawley. It is located at the head of the canal, 3¾ miles north of Bishop, Cal.

The channel is straight for 50 feet below the gage. The current is swift. Both banks are high and will not overflow. The bed of the stream is rocky and permanent.

Discharge measurements are made from a footbridge. The initial point for soundings is marked on the footbridge, near the right bank.

The gage is a vertical board fastened to the headworks of the canal. No gage reader could be obtained for this station, but since the gage was installed there has been little variation in the amount of water flowing in the canal.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 213; 134, pp 219–220.
Discharge: 100, p 213; 134, p 220.
Discharge, monthly: 134, p 221.
Gage heights: 134, pp 220–221.
Rating table: 134, p 221.

*Discharge measurements of McNally canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 17 | R. J. Taylor | 20 | 11.2 | 1.06 | 0.50 | 11.9 |
| April 6 | J. S. Evans | 20 | 14.2 | 1.76 | .70 | 25 |
| April 24 | do | 21 | 18.2 | 2.09 | 1.00 | 38 |
| May 12 | do | 21 | 21 | 2.05 | 1.05 | 43 |
| June 1 | do | 21 | 25 | 2.23 | 1.10 | 56 |
| July 7 | do | 22 | 32 | 2.69 | 1.30 | 86 |
| August 4 | do | 22 | 32 | 1.66 | 1.50 | 53 |
| September 11 | do | 21 | 23 | 2.17 | 1.10 | 50 |
| November 22 | F. R. S. Buttemer | 21 | 17.5 | 1.14 | .70 | 20 |
| December 13[a] | do | | | | .10 | 0 |

[a] Headgate shut down; no water in canal.

### GEORGE COLLINS CANAL NEAR BISHOP, CAL.

This station was established August 17, 1903, by R. S. Hawley. It is located at the footbridge 3 miles east and one-half mile north of Bishop, Cal.

The channel is straight for 75 feet above and for 50 feet below the station. The current is sluggish. The right bank is low and the left bank is high. Neither bank is liable to overflow. The bed of the stream is composed of sand and is fairly permanent.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the footbridge near the right bank of the canal.

The gage is a vertical rod fastened to the bridge near the house of Arthur Wines.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 213; 134, p 222.
Discharge: 100, p 214; 134, p 222.
Discharge, monthly: 134, p 225.
Gage heights: 100, p 214; 134, pp 223–224.
Rating table: 134, p 224.

*Discharge measurements of George Collins canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 2 | J. S. Evans | 11 | 10.8 | 1.12 | 1.10 | 12.1 |
| May 25 | ....do | 14 | 13 | 1.13 | 1.35 | 14 |
| June 28 | ....do | 11.5 | 7.3 | .71 | 1.00 | 5.2 |
| July 26 | ....do | 11.5 | 9.1 | .65 | 1.00 | 5.9 |
| August 9 | ....do | 11.5 | 8.0 | .50 | .60 | 4.0 |
| September 5 | ....do | 12 | 8.4 | .57 | .60 | 4.8 |
| September 14 | ....do | 11.6 | 8.0 | .65 | .50 | 5.2 |
| October 3 | ....do | 12 | 8.8 | 1.00 | .65 | 8.8 |
| October 25 | F. R. S. Buttemer | 11 | 5.8 | .59 | .78 | 3.4 |
| November 23 | ....do | 11.5 | 5.2 | .65 | .82 | 3.4 |
| December 11 | ....do | 10.7 | 4.7 | .53 | .80 | 2.5 |

*Daily gage height, in feet, of George Collins canal near Bishop, Cal., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.9 | | 0.8 | | 1.0 | 17 | 1.0 | 1.4 | 1.2 | 0.9 | | |
| 2 | 0.9 | 1.0 | | .8 | 0.8 | .9 | 18 | 1.0 | 1.5 | | .9 | 1.2 | |
| 3 | | 1.0 | 0.8 | | .8 | | 19 | 1.0 | 1.4 | | | | |
| 4 | .9 | | | | | .9 | 20 | 1.0 | | 1.0 | | 1.2 | |
| 5 | | 1.0 | | .5 | .8 | | 21 | | 1.0 | | .9 | 1.1 | |
| 6 | | 1.0 | .8 | | | .9 | 22 | 1.0 | 1.0 | 1.0 | | | |
| 7 | 1.0 | 1.2 | .9 | .5 | .9 | | 23 | | | | .8 | 1.1 | |
| 8 | | 1.5 | | | | | 24 | 1.0 | .9 | | .8 | 1.1 | |
| 9 | .8 | 1.5 | 1.4 | .5 | 1.2 | | 25 | | .9 | | | | |
| 10 | | 1.4 | | .5 | | | 26 | | 1.0 | .9 | | 1.0 | |
| 11 | .8 | .8 | 1.4 | | 1.2 | | 27 | .6 | | | .9 | | |
| 12 | | 1.5 | 1.4 | | 1.2 | | 28 | .5 | | | | 1.0 | |
| 13 | | 1.6 | | .8 | | | 29 | .5 | .8 | .9 | .9 | | |
| 14 | .8 | 1.6 | 1.4 | .9 | | | 30 | .6 | .8 | | .9 | | |
| 15 | 1.0 | 1.4 | | | 1.2 | | 31 | | | | | | |
| 16 | 1.0 | 1.4 | 1.2 | | | | | | | | | | |

NOTE.—Water shut off October 6 to December 31.

## BISHOP CREEK NEAR BISHOP, CAL.

This station was established August 10, 1903, by J. C. Clausen and R. S. Hawley. It is located at the wagon bridge on the Bishop road about 4½ miles from Bishop and about 2 miles from the point where the creek leaves the canyon. North Hillside canal, South Hillside canal, and Powers canal are taken out above the station.

The channel is straight for 100 feet above and for 50 feet below the station. The current is swift. Both banks are high and rocky and are not liable to overflow. The bed of the stream is rough and rocky and is permanent.

Discharge measurements are made from the wagon bridge. The initial point for soundings is marked on the bridge near the right bank of the stream.

The gage is a vertical rod fastened in the rocks and braced to the right bank just above the wagon bridge. During 1905 the gage was read once each day by A. S. Kilpatrick. The bench mark is a large flat granite bowlder on the right bank 40 feet above the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 214-215; 134, p 225.
Discharge: 100, p 215; 134, p 226.
Discharge, monthly: 134, p 228.
Gage heights: 100, p 215; 134, pp 226-227.
Rating table: 134, p 228.

*Discharge measurements of Bishop Creek near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 11 | R. J Taylor | 16 | 22 | 1.18 | 1.40 | 26 |
| February 8 | do | 16 | 24 | 1.25 | 1.55 | 30 |
| March 4 | do | 16 | 23 | 1.35 | 1.55 | 31 |
| April 3 | J. S. Evans | 16 | 20 | 2.10 | 1.65 | 42 |
| April 18 | do | 16 | 22 | 1.50 | 1.57 | 33 |
| May 5 | do | 16 | 34 | 2.76 | 2.30 | 94 |
| June 21 | do | 19 | 63 | 6.21 | 3.80 | 391 |
| July 10 | do | 18 | 61 | 5.54 | 3.60 | 338 |
| July 27 | do | 17 | 44 | 4.01 | 2.75 | 178 |
| August 10 | do | 16 | 37 | 3.35 | 2.50 | 124 |
| September 7 | do | 16 | 28 | 2.07 | 2.00 | 58 |
| September 22 | do | 16 | 24 | 1.91 | 1.80 | 46 |
| October 25 | F. R. S. Buttemer | 15 | 25 | .84 | 1.35 | 21 |
| November 23 | do | 16 | 19.6 | 1.22 | 1.52 | 24 |
| December 11 | do | 16 | 22 | 1.05 | 1.67 | 23 |
| December 21 | do | 14 | 15.6 | .79 | 1.21 | 12.4 |

*Daily gage height, in feet, of Bishop Creek near Bishop, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.5 | 1.55 | 1.8 | 2.5 | 2.9 | 3.4 | 2.5 | 2.1 | 1.9 | 1.4 | 1.5 |
| 2 | 1.4 | 1.5 | 1.55 | 1.8 | 2.5 | 2.9 | 3.3 | 2.3 | 2,1 | 1.9 | 1.4 | 1.4 |
| 3 | 1.4 | 1.45 | 1.5 | 1.75 | 2.5 | 2.9 | 3.2 | 2.3 | 2.1 | 1.8 | 1.4 | 1.5 |
| 4 | 1.4 | 1.5 | 1.6 | 1.75 | 2.3 | 2.9 | 3.3 | 2.3 | 2.0 | 1.9 | 1.4 | 1.4 |
| 5 | 1.4 | 1.5 | 1.6 | 1.75 | 2.3 | 3.0 | 3.3 | 2.2 | 2.0 | 1.8 | 1.4 | 1.4 |
| 6 | 1.4 | 1.5 | 1.6 | 1.8 | 2.1 | 3.1 | 3.3 | 2.2 | 1.9 | 1.8 | 1.4 | 1.5 |
| 7 | 1.45 | 1.5 | 1.6 | 1.8 | 2.1 | 3.3 | 3.4 | 2.2 | 1.8 | 1.8 | 1.4 | 1.5 |
| 8 | 1.45 | 1.5 | 1.6 | 1.8 | 2.1 | 3.4 | 3.4 | 2.3 | 1.9 | 1.8 | 1.5 | 1.5 |
| 9 | 1.4 | 1.5 | 1.6 | 1.75 | 2.0 | 3.3 | 3.5 | 2.4 | 1.9 | 1.8 | 1.5 | 1.5 |
| 10 | 1.4 | 1.55 | 1.6 | 1.75 | 2.0 | 3.4 | 3.6 | 2.5 | 1.9 | 1.8 | 1.4 | 1.4 |
| 11 | 1.4 | 1.5 | 1.6 | 1.7 | 2.0 | 3.5 | 3.7 | 2.6 | 1.8 | 1.8 | 1.4 | 1.4 |
| 12 | 1.4 | 1.5 | 1.65 | 1.7 | 2.1 | 3.6 | 3.7 | 2.5 | 1.7 | 1.7 | 1.5 | 1.5 |
| 13 | 1.4 | 1.45 | 1.65 | 1.7 | 2.1 | 3.6 | 3.6 | 2.4 | 1.8 | 1.7 | 1.5 | 1.5 |
| 14 | 1.4 | 1.45 | 1.7 | 1.75 | 2.1 | 3.6 | 3.2 | 2.35 | 1.8 | 1.7 | 1.4 | 1.5 |
| 15 | 1.45 | 1.45 | 1.7 | 1.75 | 2.2 | 3.7 | 3.0 | 2.3 | 1.7 | 1.7 | 1.5 | 1.5 |
| 16 | 1.45 | 1.4 | 1.7 | 1.75 | 2.2 | 3.8 | 2.8 | 2.2 | 1.7 | 1.6 | 1.4 | 1.5 |
| 17 | 1.45 | 1.4 | 1.65 | 1.75 | 2.5 | 3.8 | 2.7 | 2.2 | 1.9 | 1.6 | 1.5 | 1.4 |
| 18 | 1.5 | 1.4 | 1.65 | 1.7 | 2.5 | 3.8 | 2.6 | 2.2 | 1.8 | 1.6 | 1.5 | 1.4 |
| 19 | 1.5 | 1.4 | 1.7 | 1.7 | 2.6 | 3.8 | 2.6 | 2.2 | 1.9 | 1.6 | 1.6 | 1.5 |
| 20 | 1.45 | 1.4 | 1.7 | 1.7 | 2.7 | 3.8 | 2.5 | 2.2 | 1.8 | 1.5 | 1.6 | 1.5 |
| 21 | 1.45 | 1.4 | 1.7 | 1.7 | 2.5 | 3.8 | 2.5 | 2.3 | 1.9 | 1.5 | 1.5 | 1.4 |
| 22 | 1.4 | 1.4 | 1.7 | 1.7 | 2.5 | 3.8 | 2.5 | 2.2 | 1.8 | 1.5 | 1.5 | 1.5 |
| 23 | 1.4 | 1.5 | 1.7 | 1.8 | 2.5 | 3.7 | 2.6 | 2.2 | 1.8 | 1.5 | 1.5 | 1.4 |
| 24 | 1.4 | 1.5 | 1.7 | 1.8 | 2.6 | 3.6 | 2.6 | 2.2 | 1.9 | 1.4 | 1.5 | 1.5 |
| 25 | 1.4 | 1.5 | 1.75 | 2.0 | 2.6 | 3.3 | 2.7 | 2.2 | 1.9 | 1.4 | 1.5 | 1.4 |
| 26 | 1.4 | 1.5 | 1.75 | 2.4 | 2.6 | 3.3 | 2.7 | 2.2 | 1.9 | 1.4 | 1.5 | 1.4 |
| 27 | 1.4 | 1.5 | 1.8 | 2.4 | 2.7 | 3.2 | 2.8 | 2.2 | 1.9 | 1.4 | 1.5 | 1.5 |
| 28 | 1.4 | 1.5 | 1.8 | 2.5 | 2.8 | 3.2 | 2.8 | 2.1 | 1.8 | 1.4 | 1.5 | 1.5 |
| 29 | 1.45 | ....... | 1.8 | 2.5 | 2.8 | 3.2 | 2.7 | 2.1 | 1.8 | 1.4 | 1.6 | 1.6 |
| 30 | 1.45 | ....... | 1.8 | 2.5 | 2.8 | 3.3 | 2.6 | 2.1 | 1.7 | 1.4 | 1.6 | 1.7 |
| 31 | 1.45 | ....... | 1.8 | ....... | 2.8 | ....... | 2.5 | 2.0 | ....... | 1.4 | ....... | 1.6 |

NOTE.—Gage heights interpolated February 17-19.

*Station rating table for Bishop Creek near Bishop, Cal., from January 1 to December 11, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 21 | 2.10 | 74 | 2.80 | 170 | 3.50 | 314 |
| 1.50 | 27 | 2.20 | 84 | 2.90 | 188 | 3.60 | 339 |
| 1.60 | 33 | 2.30 | 95 | 3.00 | 206 | 3.70 | 365 |
| 1.70 | 40 | 2.40 | 108 | 3.10 | 225 | 3.80 | 391 |
| 1.80 | 48 | 2.50 | 122 | 3.20 | 245 | | |
| 1.90 | 56 | 2.60 | 137 | 3.30 | 267 | | |
| 2.00 | 65 | 2.70 | 153 | 3.40 | 290 | | |

NOTE.—The above table is based on 14 discharge measurements made during 1905 and some older measurements. It is not very well defined. This table does not apply later than December 11, as conditions were changed at the station.

*Estimated monthly discharge of Bishop Creek near Bishop, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 27 | 21 | 22.5 | 1,384 |
| February | 30 | 21 | 25.2 | 1,400 |
| March | 48 | 27 | 38.2 | 2,349 |
| April | 122 | 40 | 56.6 | 3,368 |
| May | 170 | 65 | 113 | 6,948 |
| June | 391 | 188 | 299 | 17,790 |
| July | 365 | 122 | 215 | 13,220 |
| August | 137 | 65 | 92.1 | 5,663 |
| September | 74 | 40 | 53.6 | 3,189 |
| October | 56 | 21 | 36.1 | 2,220 |
| November | 33 | 21 | 25.6 | 1,523 |
| December 1-11 | 27 | 21 | 24.3 | 530 |
| The period | .......... | .......... | .......... | 59,580 |

### RAWSON CANAL NEAR BISHOP, CAL.

This station was established August 7, 1903, by R. S. Hawley. It is located at the county bridge 2½ miles east of Bishop, Cal.

The channel is straight for 100 feet above and below the station and the current is swift. The right bank is high and the left bank is low. Neither bank is liable to overflow. The bed of the stream is composed of gravel and is permanent.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the bridge near the right bank of the canal.

The gage is a vertical rod fastened to the bridge. During 1905 the gage was read by W. P. Parker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 215-216; 134, p 229.
Discharge: 100, p 216; 134, p 229.
Discharge, monthly: 134, p 231.
Gage heights: 100, p 216; 134, pp 230-231.
Rating table: 134, p 231.

*Discharge measurements of Rawson canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sc.* | *Feet.* | *Sec.-ft.* |
| March 14 | R. J. Taylor | 17 | 13.2 | 1.67 | 1.75 | 22 |
| April 1 | J. S. Evans | 17 | 13.3 | 1.95 | 1.85 | 26 |
| April 17 | do | 17 | 10.6 | 1.59 | 1.60 | 16.9 |
| May 2 | do | 17 | 16.3 | 1.72 | 1.90 | 28 |
| May 25 | do | 17 | 17.4 | 1.55 | 1.90 | 27 |
| June 28 | do | 17 | 14.8 | 1.22 | 1.70 | 18.1 |
| July 26 | do | 14 | 5.4 | .39 | 1.30 | 2.1 |
| August 9 | do | 17 | 14.6 | 1.00 | 1.55 | 14.6 |
| September 5 | do | 16 | 9.8 | .72 | 1.45 | 7.0 |
| September 14 | do | 17 | 10.1 | 1.05 | 1.50 | 10.6 |
| October 3 | do | 17 | 15.2 | 1.17 | 1.90 | 17.8 |
| October 25 | F. R. S. Buttemer | 7 | 4.2 | .29 | 1.05 | 1.2 |
| November 23 | do | 6 | 1.6 | .69 | 1.15 | 1.1 |
| December 11 | do | 7 | 4.2 | .31 | 1.08 | 1.3 |

*Daily gage height, in feet, of Rawson canal near Bishop, Cal., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.8 | 1.7 | 1.8 | 0.8 | 0.9 | 1.3 | 1.8 |
| 2 | ........ | ........ | 1.7 | 1.8 | .9 | .9 | ........ | 1.8 |
| 3 | ........ | 1.8 | 1.7 | 1.8 | .9 | .8 | 1.3 | 1.8 |
| 4 | ........ | 1.8 | 1.9 | 1.8 | .9 | .8 | 1.5 | 1.8 |
| 5 | ........ | 1.8 | ........ | 1.7 | .9 | .8 | 1.5 | 1.8 |
| 6 | 1.4 | ........ | 1.9 | 1.9 | .8 | .8 | 1.5 | 1.8 |
| 7 | 1.4 | 1.7 | 1.9 | 1.9 | .8 | .8 | 1.7 | 1.6 |
| 8 | 1.5 | 1.7 | 1.8 | 1.9 | .8 | .8 | 1.7 | 1.4 |
| 9 | 1.5 | ........ | 1.8 | 1.8 | .8 | .8 | 1.7 | 1.4 |
| 10 | 1.6 | 1.7 | 1.8 | 1.8 | .8 | .8 | 1.7 | 1.4 |
| 11 | 1.6 | 1.7 | 1.8 | 1.9 | .7 | .8 | 1.7 | 1.4 |
| 12 | 1.6 | 1.7 | 1.8 | 1.8 | .7 | .8 | 1.7 | 1.6 |
| 13 | 1.8 | ........ | 1.8 | 1.8 | .7 | .9 | 1.6 | 1.6 |
| 14 | 1.8 | 1.7 | 1.8 | 1.7 | .8 | .9 | 1.6 | ........ |
| 15 | ........ | 1.6 | 1.9 | 1.0 | .8 | .0 | 1.6 | ........ |
| 16 | ........ | 1.6 | 1.9 | .9 | .8 | ........ | 1.6 | ........ |
| 17 | ........ | 1.6 | 1.9 | 1.4 | .8 | .9 | 1.6 | ........ |
| 18 | ........ | 1.6 | 1.9 | 1.4 | .8 | .9 | 1.6 | ........ |
| 19 | ........ | 1.6 | 1.9 | ........ | .8 | .9 | 1.6 | ........ |
| 20 | ........ | 1.7 | 1.9 | ........ | .8 | ........ | 1.6 | ........ |
| 21 | ........ | 1.7 | 1.8 | ........ | .8 | .7 | 1.7 | ........ |
| 22 | ........ | 1.7 | 1.9 | .6 | .7 | .7 | 1.7 | ........ |
| 23 | ........ | ........ | 1.9 | .8 | .7 | .7 | ........ | ........ |
| 24 | ........ | 1.7 | 1.8 | .9 | .7 | .7 | 1.7 | ........ |
| 25 | ........ | 1.7 | 1.8 | .9 | .7 | .7 | 1.7 | ........ |
| 26 | ........ | 1.7 | 1.8 | .9 | ........ | 1.3 | 1.7 | ........ |
| 27 | ........ | 1.7 | 1.8 | .8 | ........ | 1.3 | 1.7 | ........ |
| 28 | ........ | 1.7 | 1.8 | .8 | ........ | 1.3 | 1.7 | ........ |
| 29 | ........ | 1.7 | 1.7 | .8 | .9 | ........ | 1.7 | ........ |
| 30 | 1.8 | 1.7 | 1.7 | .8 | .9 | 1.3 | ........ | ........ |
| 31 | 1.8 | ........ | 1.7 | ........ | .9 | ........ | ........ | ........ |

NOTE.—Water shut off January 1 to March 5 and October 14 to December 31.

### A. O. COLLINS CANAL NEAR BISHOP, CAL.

This station was established August 7, 1903, by R. S. Hawley. It is located at the county bridge, 3 miles east of Bishop, Cal.

The channel is straight for 100 feet above and 50 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is sandy and shifting.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the foot log near the right bank of the canal.

The gage is a vertical rod fastened to the right bank just above the bridge, from which discharge measurements are made. During 1905 the gage was read by W. P. Parker.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 216-217; 134, p 232.
Discharge: 100, p 217; 134, p 232.
Discharge, monthly: 134, p 235.
Gage heights: 100, p 217; 134, pp 233-234
Rating table: 134, p 234.

*Discharge measurements of A. O. Collins canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 14 | R. J. Taylor | 11 | 12.5 | 2.00 | 2.90 | 25 |
| April 1 | J. S. Evans | 8 | 2.8 | .75 | 2.00 | 2.1 |
| May 2 | do | 11.5 | 12.8 | 1.95 | 3.00 | 25 |
| June 28 | do | 10 | 10.8 | 1.70 | 2.75 | 18.4 |
| July 26 | do | 10 | 12.8 | 1.44 | 2.90 | 18.4 |
| August 9 | do | 10 | 8.8 | 1.59 | 2.65 | 14.0 |
| September 5 | do | 10 | 6.0 | 1.22 | 2.38 | 7.3 |
| September 14 | do | 10 | 5.4 | 1.20 | 2.33 | 6.5 |
| October 3 | do | 10 | 10.4 | 1.47 | 2.80 | 15.3 |
| October 25 | F. R. S. Buttemer | | | | | 0 |
| November 23 | do | 10.5 | 7.0 | .70 | 2.25 | 4.9 |
| December 11 | do | 10 | 3.8 | .45 | 1.92 | 1.7 |

*Daily gage height, in feet, of A. O. Collins canal near Bishop, Cal., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | 2.6 | 1.8 | 2.5 | 2.5 | 2.4 | 2.5 |
| 2 | | | | 2.6 | 1.8 | 2.5 | 2.0 | | 2.5 |
| 3 | | | | 2,8 | 1.6 | 2.7 | | 2.6 | 2.5 |
| 4 | | | | 3.0 | 1.9 | 2.7 | | 2.6 | 2.2 |
| 5 | | | | | 1.9 | 2.8 | | 2.6 | 2.2 |
| 6 | | | | 3.0 | 1.7 | 2.8 | | 2.6 | 2.2 |
| 7 | | | | 3.0 | 1.7 | 2.8 | | 2.3 | 2.2 |
| 8 | | | | 2.4 | 1.8 | 2.9 | | 2.0 | 2.2 |
| 9 | | | | 2.3 | 1.9 | 2.9 | | 2.0 | 2.2 |
| 10 | | 2.4 | | 2.3 | 1.9 | 3.0 | 2.3 | 2.0 | 2.2 |
| 11 | | 2.4 | | 2.3 | 1.9 | 3.0 | 2.3 | 2.0 | 2.3 |
| 12 | | 2.4 | | 2.3 | 1.9 | 3.0 | 2.3 | 2.0 | 2.3 |
| 13 | | 2.8 | | 2.3 | 2.2 | 3.0 | 2.3 | 2.3 | 2.3 |
| 14 | | 2.8 | | 2.3 | 2.3 | 2.9 | 2.3 | 2.3 | |
| 15 | | 2.8 | | 2.3 | 2.3 | 2.9 | | 2.3 | |
| 16 | | 2.8 | | | 2.4 | 2.9 | | 2.3 | |
| 17 | | 2.8 | | | | 2.9 | 2.3 | 2.9 | |
| 18 | | 2.8 | | | | 2.9 | 2.1 | 2.9 | |
| 19 | | 2.8 | 2.6 | | | 2.8 | 2.1 | 2.9 | |
| 20 | | 2.8 | 2.6 | | | 2.8 | | 2.9 | |
| 21 | | 2.8 | 2.6 | | | 2.8 | 2.1 | 2.9 | |
| 22 | 2.3 | 3.0 | 2.6 | | 2.3 | 2.8 | 2.1 | 2.7 | |
| 23 | | 3.0 | | | 2.3 | 2.7 | 2.0 | | |
| 24 | | 3.0 | 2.5 | | 2.3 | 2.7 | 2.0 | 2.7 | |
| 25 | | 2.7 | 2.5 | | 2.6 | 2.7 | 2.0 | 2.7 | |
| 26 | 2.3 | | 2.5 | | 2.6 | 2.7 | 2.0 | 2.7 | |
| 27 | | | 2.5 | | 2.6 | | 2.0 | 2.5 | |
| 28 | | | 2.6 | | 2.6 | | 2.4 | 2.5 | |
| 29 | | | 2.6 | | 2.6 | 2.7 | | 2.5 | |
| 30 | | | 2.6 | | 2.5 | 2.7 | 2.4 | | |
| 31 | | | | 1.7 | | 2.5 | | | |

**Note.**—No flow on days of missing gage heights.

## DELL CANAL NEAR BISHOP, CAL.

This station was established August 24, 1903, by R. S. Hawley. It is located at a flume 3 miles from the head gate at a point where the canal crosses a slough in Sanders's field.

The channel is straight for 150 feet above and for 200 feet below the station. The current is sluggish at all times.

Discharge measurements are made from a bridge across the flume. The initial point for soundings is the edge of the flume at the right side.

The gage is a vertical rod fastened to the flume.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 217-218; 134, p 235.
Discharge: 100, p 218; 134, pp 235-236.
Discharge, monthly: 134, p 237.
Gage heights: 100, p 218; 134, pp 236-237.

*Discharge measurements of Dell canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 10 | R. J. Taylor | 7.5 | 10.1 | 2.38 | 1.40 | 24 |
| April 14 | J. S. Evans | 7.6 | 7.6 | 2.16 | 1.20 | 16.4 |
| April 28 | do | 7.6 | 11.8 | 1.95 | 1.35 | 23 |
| May 11 | do | 7.6 | 12.5 | 2.08 | 1.48 | 26 |
| June 26 | do | 7.6 | 11.4 | 1.93 | 1.60 | 22 |
| July 6 | do | 7.6 | 12.2 | 1.97 | 1.70 | 24 |
| August 2 | do | 7.6 | 9.1 | 1.89 | 1.30 | 17.2 |
| September 6 | do | 7.6 | 9.1 | 1.85 | 1.31 | 16.8 |
| September 28 | do | 7.6 | 6.8 | 1.70 | 1.12 | 11.6 |
| October 30 | F. R. S. Buttemer | 7.5 | 9.0 | 1.52 | 1.22 | 13.7 |
| November 18 | do | 7.5 | 9.7 | 1.71 | 1.35 | 16.6 |
| December 5 | do | 7.3 | 4.4 | .68 | .62 | 3.0 |

*Daily gage height, in feet, of Dell canal near Bishop, Cal., for 1905.*

| Day. | Feb. | Mar. | Apr. | Nov. | Dec. | Day. | Feb. | Mar. | Apr. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1.3 | | | 17 | | | | | |
| 2 | | 1.4 | | | 0.9 | 18 | | 1.4 | | 1.35 | |
| 3 | | | | | | 19 | | | | | |
| 4 | | 1.4 | | | .8 | 20 | | 1.4 | | 1.3 | |
| 5 | | | | | | 21 | | | | | |
| 6 | | 1.4 | | | .6 | 22 | | 1.4 | | 1.3 | |
| 7 | | | | | | 23 | | | | | |
| 8 | | 1.4 | | | .6 | 24 | | 1.2 | | 1.3 | |
| 9 | | | | | | 25 | | | | | |
| 10 | | 1.4 | | | .6 | 26 | 1.4 | 1.2 | | 1.3 | |
| 11 | | | | | | 27 | | | | | |
| 12 | | 1.4 | | | .8 | 28 | 1.4 | 1.2 | | 1.4 | |
| 13 | | | | | | 29 | | | | | |
| 14 | | 1.4 | | | .8 | 30 | | 1.2 | | 1.35 | |
| 15 | | | | | | 31 | | | | | |
| 16 | | 1.4 | | | .8 | | | | | | |

### BIG PINE AND OWENS RIVER CANAL NEAR BISHOP, CAL.

This station was established by J. C. Clausen and R. S. Hawley, August 4, 1903. It is located at a footbridge near the house of William Oliver, the observer. It is 7½ miles south and 3 miles east of Bishop, Cal.

The channel is straight for 600 feet above and 300 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is sandy and somewhat shifting.

Discharge measurements are made from the footbridge. The initial point for soundings is marked on the footbridge near the right bank of the canal.

The gage is a vertical rod securely nailed to the footbridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 218–219; 134, p 238.
Discharge: 100, p 219; 134, p 238.
Discharge, monthly: 134, p 240.
Gage heights: 100, p 219; 134, pp 238–239.
Rating table: 134, p 240.

*Discharge measurements of Big Pine and Owens River canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 25 | R. J. Taylor | 22 | 11.3 | 0.84 | 1.30 | 9.5 |
| February 13 | do | 22 | 9.5 | .70 | 1.15 | 6.7 |
| April 28 | J. S. Evans | 21 | 12.6 | .85 | 1.30 | 10.7 |
| May 11 | do | 22 | 16 | 1.11 | 1.50 | 17.7 |
| June 26 | do | 22 | 27 | 1.11 | 1.90 | 30 |
| July 6 | do | 22 | 18.8 | 1.05 | 1.75 | 19.6 |
| August 2 | do | 22 | 10.8 | .58 | 1.20 | 6.3 |
| September 6 | do | 16 | 10.0 | .59 | 1.17 | 5.9 |
| September 28 | do | 14 | 7.2 | .36 | 1.10 | 2.6 |
| October 30 | F. R. S. Buttemer | 22 | 41 | 1.00 | 2.53 | 41 |
| November 18 | do | 22 | 17.6 | .85 | 1.42 | 15 |
| December 5 | do | 22 | 18.2 | .89 | 1.45 | 16.2 |

*Daily gage height, in feet, of Big Pine and Owens River canal near Bishop, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.4 | 1.2 | 1.15 | 1.4 | 2.0 | 1.8 | 1.1 | 1.2 | 1.4 | 2.55 | 1.4 |
| 2 | 1.2 | 1.4 | 1.2 | 1.15 | 1.8 | 1.85 | 1.8 | 1.1 | 1.1 | 1.3 | 2.55 | 1.45 |
| 3 | 1.2 | 1.4 | 1.15 | 1.15 | 1.8 | 1.8 | 1.8 | 1.1 | 1.2 | 1.4 | 2.55 | 1.5 |
| 4 | 1.2 | 1.3 | 1.15 | 1.15 | 1.9 | 1.8 | 1.8 | 1.1 | 1.2 | 1.5 | 2.5 | 1.5 |
| 5 | 1.2 | 1.25 | 1.15 | 1.15 | 1.7 | 1.8 | 1.8 | 1.0 | 1.2 | 1.65 | 2.5 | 1.45 |
| 6 | 1.25 | 1.25 | 1.15 | 1.15 | 1.7 | 1.7 | 1.7 | 1.1 | 1.2 | 1.9 | 2.25 | 1.45 |
| 7 | 1.3 | 1.25 | 1.15 | 1.1 | 1.5 | 1.7 | 1.7 | 1.1 | 1.2 | 1.9 | 2.3 | 1.45 |
| 8 | 1.3 | 1.15 | 1.15 | 1.1 | 1.5 | 1.7 | 2.0 | 1.1 | 1.2 | 1.8 | 2.3 | 1.45 |
| 9 | 1.25 | 1.15 | 1.1 | (a) | 1.6 | 1.95 | 2.05 | 1.2 | 1.2 | 2.0 | 2.3 | 1.45 |
| 10 | 1.25 | 1,2 | 1.1 | (a) | 1.55 | 2.15 | 2.2 | 1.2 | 1.2 | 2.1 | 2.55 | 1.4 |
| 11 | 1.25 | 1.2 | 1.1 | (a) | 1.55 | 2.1 | 2.25 | 1.2 | 1.3 | 2.15 | 1.2 | 1.4 |
| 12 | 1.25 | 1.2 | 1.15 | (a) | 1.5 | 2.3 | 2.35 | 1.2 | 1.3 | 2.2 | 1.2 | 1.4 |
| 13 | 1.25 | 1.2 | 1.5 | (a) | 1.5 | 2.45 | 2.4 | 1.2 | 1.2 | 2.2 | 1.2 | 1.4 |
| 14 | 1.25 | 1.15 | 1.75 | 1.35 | 1.5 | 2.65 | 2.4 | 1.2 | 1.2 | 2.1 | 1.2 | 1.4 |
| 15 | 1.3 | 1.15 | 1.55 | 1.4 | 1.5 | 2.7 | 2.25 | 1.2 | 1.3 | 2.15 | 1.2 | 1.4 |
| 16 | 1.4 | 1.2 | 1.55 | 1.35 | 1.5 | 2.8 | 2.1 | 1.2 | 1.3 | 2.15 | 1.2 | 1.4 |
| 17 | 1.4 | 1.2 | 1.4 | 1.35 | 1.55 | 1.8 | 2.05 | 1.2 | 1.3 | 2.3 | 1.3 | 1.4 |
| 18 | 1.35 | 1.2 | 1.4 | 1.45 | 1.6 | 1.8 | 1.8 | 1.2 | 1.3 | 2.3 | 1.4 | 1.4 |
| 19 | 1.35 | 1.2 | 1.35 | 1.3 | 1.8 | 1.85 | 1.7 | 1.1 | 1.1 | 2.35 | 1.4 | 1.4 |
| 20 | 1.4 | 1.2 | 1.35 | 1.3 | 2.1 | 1.7 | 1.6 | 1.1 | 1.15 | 2.35 | 1.35 | 1.4 |
| 21 | 1.4 | 1.15 | 1.35 | 1.15 | 2.15 | 1.65 | 2.0 | 1.0 | 1.15 | 2.35 | 1.3 | 1.35 |
| 22 | 1.35 | 1.15 | 1.35 | 1.15 | 2.25 | 1.7 | 1.9 | 1.0 | 1.1 | 2.35 | 1.25 | 1.35 |
| 23 | 1.35 | 1.15 | 1.1 | 1.1 | 2.2 | 1.8 | 2.0 | 1.5 | 1.1 | 2.35 | 1.25 | 1.35 |
| 24 | 1.35 | 1.25 | 1.1 | 1.1 | 2.25 | 2.2 | 1.6 | 1.6 | 1.1 | 2.35 | 1.25 | 1.3 |
| 25 | 1.35 | 1.25 | 1.1 | 1.1 | 2.0 | 2.2 | 1.4 | 1.5 | 1.2 | 2.35 | 1.3 | 1.3 |
| 26 | 1.35 | 1.25 | 1.1 | 1.45 | 1.8 | 1.9 | 1.3 | 1.4 | 1.2 | 2.35 | 1.3 | 1.4 |
| 27 | 1.3 | 1.3 | 1.2 | 1.4 | 2.25 | 1.8 | 1.3 | 1.4 | 1.15 | 2.35 | 1.4 | 1.4 |
| 28 | 1.3 | 1.2 | 1.2 | 1.4 | 2.25 | 1.6 | 1.2 | 1.4 | 1.15 | 2.45 | 1.4 | 1.4 |
| 29 | 1.3 | ....... | 1.2 | 1.4 | 2.45 | 1.5 | 1.1 | 1.2 | 1.15 | 2.45 | 1.4 | 1.3 |
| 30 | 1.25 | ....... | 1.1 | 1.4 | 2.4 | 1.8 | 1.1 | 1.3 | 1.15 | 2.5 | 1.4 | 1.3 |
| 31 | 1.25 | ....... | 1.1 | ....... | 2.1 | ....... | 1.1 | 1.3 | ....... | 2.55 | ....... | 1.3 |

[a] Water shut off April 9-13.

### SANGER CANAL AT ALVORD, CAL.

This station was established August 4, 1903, by J. C. Clausen and R. S. Hawley. It is located at the county road bridge, one-fourth mile east of the Southern Pacific Railroad station at Alvord, Cal.

The channel is straight for 300 feet above and for 100 feet below the station. The current is sluggish. Both banks are low and liable to overflow. The bed of the stream is shifting.

Discharge measurements are made from the bridge. The initial point for soundings is marked on the bridge near the left bank of the canal.

The gage is a vertical rod fastened to the bridge.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 219-220; 134, pp 240-241.
Discharge: 100, p 220; 134, p 241.
Gage heights: 100, p 220; 134, pp 241-242.

*Discharge measurements of Sanger canal at Alvord, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 7 | R. J. Taylor | 16 | 23 | 0.59 | 2.38 | 13.6 |
| February 18 | do | 16 | 22 | .63 | 2.32 | 13.9 |
| April 14 | J. S. Evans | 16 | 26 | .38 | 2.80 | 9.9 |
| April 26 | do | 16 | 29 | .30 | 2.88 | 8.8 |
| May 19 | do | 16 | 32 | .18 | 3.05 | 5.6 |
| June 9 | do | 16 | 29 | .16 | 2.80 | 4.7 |
| August 17 | do | 16 | 18 | .22 | 2.10 | 4.0 |
| September 13 | do | 16 | 16 | .18 | 2.10 | 2.8 |
| October 30 | F. R. S. Buttemer | 16 | 30 | .44 | 2.82 | 13.2 |
| November 18 | do | 16 | 26 | .39 | 2.60 | 10.2 |

*Daily gage height, in feet, of Sanger canal at Alvord, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Day. | Jan. | Feb. | Mar. | Apr. | May. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.2 | | 1.2 | 2.7 | 2.9 | 17 | 1.9 | | 2.2 | 2.8 | |
| 2 | | 1.7 | 1.2 | 2.7 | 2.9 | 18 | | 1.3 | 2.2 | 2.8 | 3.5 |
| 3 | 2.1 | | | | | 19 | 1.8 | 1.3 | 2.2 | | |
| 4 | | 1.6 | 1.2 | 2.8 | 2.9 | 20 | | | | 2.8 | 3.5 |
| 5 | 2.1 | 1.6 | 1.2 | | | 21 | 1.8 | 1.3 | 2.4 | | |
| 6 | | | | 2.8 | 3.0 | 22 | 1.8 | | | 2.8 | |
| 7 | 2.1 | 1.5 | 1.2 | | 3.0 | 23 | | 1.3 | 2.4 | | |
| 8 | 2.1 | | | 2.9 | | 24 | 1.8 | | | 2.8 | |
| 9 | | 1.5 | 1.8 | 2.9 | 3.1 | 25 | | 1.3 | 2.4 | | |
| 10 | 2.0 | | | | | 26 | 1.8 | 1.3 | 2.4 | 2.8 | |
| 11 | | 1.4 | 2.0 | 2.9 | 3.3 | 27 | | | | | |
| 12 | 2.0 | 1.4 | 2.1 | | | 28 | 1.7 | 1.2 | 2.6 | 2.8 | |
| 13 | | | | 2.9 | 3.4 | 29 | 1.7 | | | 2.8 | |
| 14 | 1.9 | 1.3 | 2.1 | | 3.4 | 30 | | | 2.7 | 2.8 | |
| 15 | 1.9 | | | 2.8 | | 31 | 1.7 | | 2.7 | | |
| 16 | | 1.3 | 2.2 | 2.8 | 3.4 | | | | | | |

## EAST SIDE CANAL NEAR CITRUS, CAL.

This station was established August 27, 1903, by R. S. Hawley. It is located at the head gate of the canal.

At low stages the meter measurements are made by wading at a point below the head gate. High-stage measurements are made from Southern Pacific Railroad bridge, one-half mile below head gate.

The gage is a vertical rod fastened to the head gate at which discharge measurements are made. During 1905 the gage was read by J. Vaughn.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 220; 134, pp 242–243.
Discharge: 100, p 221; 134, p 243.
Discharge, monthly: 134, p 245.
Gage heights: 100, p 221; 134, pp 243–244.
Rating table: 134, p 245.

*Discharge measurements of East Side canal near Citrus, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 2 | R. J. Taylor | 20 | 21 | 1.48 | 2.30 | 31 |
| May 29 | J. S. Evans | 21 | 28 | 1.14 | 2.60 | 32 |
| August 23 | do | 24 | 35 | .63 | 3.10 | 22 |
| September 20 | do | 21 | 28 | .50 | 3.00 | 14 |
| November 8 | F. R. S. Buttemer | 18 | 27 | .66 | 2.63 | 18 |
| December 3 | do | 11 | 3.7 | 1.30 | 1.90 | 4.8 |

*Daily gage height, in feet, of East Side canal near Citrus, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 2.5 | | | | 3.0 | | | 2.0 |
| 2 | | | | | | 2.4 | | | | 3.1 | | |
| 3 | | 2.3 | 2.3 | 2.5 | | | 3.4 | | | | 3.0 | |
| 4 | | | | | | | | 3.3 | 3.1 | | | 2.1 |
| 5 | | | | | 2.5 | 2.6 | | | | | | |
| 6 | 2.3 | 2.0 | 2.3 | | | | | | | 3.1 | 2.9 | |
| 7 | | | | 2.5 | | | 3.3 | 3.3 | | | | |
| 8 | | | | | 2.5 | | | | 3.1 | | | 2.1 |
| 9 | 2.4 | | | | | 3.0 | | | | 3.1 | | |
| 10 | | 2.0 | 2.4 | 2.5 | | | 3.3 | | | | 2.9 | |
| 11 | | | | | | | | 3.1 | 3.1 | | | 2.1 |
| 12 | | | | | 2.5 | 3.2 | | | | | | |
| 13 | 2.2 | 2.0 | 2.6 | | | | | | | 3.1 | 2.8 | |
| 14 | | | | 2.6 | | | 3.3 | 3.1 | | | | |
| 15 | | | | | 2.6 | | | | 3.1 | | | 2.1 |
| 16 | 2.3 | | | | | 3.2 | | | | 3.1 | | |
| 17 | | 2.1 | 2.5 | 2.6 | | | 3.2 | | | | 2.8 | |
| 18 | | | | | | | | 3.1 | 3.1 | | | 2.1 |
| 19 | | | | | 2.6 | 3.2 | | | | | | |
| 20 | 2.3 | 2.2 | 2.1 | | | | | | | 3.2 | 2.7 | |
| 21 | | | | 2.6 | | | 3.1 | 3.1 | | | | |
| 22 | | | | | 2.5 | | | | 3.1 | | | 2.1 |
| 23 | 2.2 | | | | | 3.2 | | | | 3.2 | | |
| 24 | | 2.2 | 2.2 | 2.6 | | | 3.2 | | | | 2.6 | |
| 25 | | | | | | | | 3.2 | 3.0 | | | 2.0 |
| 26 | | | | | 2.5 | 3.2 | | | | | | |
| 27 | 2.3 | 2.2 | 2.5 | | | | | | | 3.2 | 2.6 | |
| 28 | | | | 2.5 | | | 3.2 | 3.1 | | | | |
| 29 | | | | | 2.6 | | | | 3.1 | | | 1.9 |
| 30 | 2.3 | | | | | 2.3 | | | | 3.0 | | |
| 31 | | | 2.5 | | | | 3.2 | | | | | |

### STEVENS CANAL NEAR CITRUS, CAL.

This station was established August 27, 1903, by R. S. Hawley. It is located at the waste gate of the canal, 3½ miles north of Citrus, Cal.

The channel is straight for 300 feet above and 200 feet below the station. The current is sluggish. Both banks are high and are not liable to overflow. The bed of the stream is composed of gravel and earth and is fairly permanent.

Discharge measurements are made by wading. The initial point for soundings is on the right bank of the canal.

The gage is a vertical rod fastened to the waste gate. During 1905 the gage was read by J. Vaughn.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 221; 134, p 245.
Discharge: 100, p 222; 134, p 246.
Discharge, monthly: 134, p 248.
Gage heights: 100, p 222; 134, pp 246-247
Rating table: 134, pp 247-248.

*Discharge measurements of Stevens canal near Citrus, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| May 29 | J. S. Evans | 12 | 29 | 1.28 | 2.70 | 37 |
| August 23 | do | 12 | 26 | .71 | 2.50 | 18.5 |
| September 20 | do | 12 | 25 | .92 | 2.55 | 23 |
| November 8 | F. R. S. Buttemer | 13 | 11.6 | .92 | 1.80 | 10.7 |
| December 3 | do | 11 | 9.6 | .76 | 1.65 | 7.3 |

*Daily gage height, in feet, of Stevens canal near Citrus, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.6 | 1.9 | | 2.1 | | | | 2.3 | | 2.8 | 2.5 |
| 2 | 1.6 | | | | | 2.8 | | 2.5 | | 2.6 | | |
| 3 | | 1.6 | 1.8 | 1.5 | 2.2 | | 2.8 | | | | 2.8 | |
| 4 | 1.6 | | | | | | | 2.5 | 2.4 | 2.6 | | 1.8 |
| 5 | | | | 1.5 | 2.3 | 2.8 | 2.9 | | | | | |
| 6 | 1.5 | 1.5 | 1.9 | | | | | | 2.4 | 2.6 | 2.8 | 1.8 |
| 7 | | | | 1.5 | | 2.8 | 2.8 | 2.5 | | | | |
| 8 | | 1.5 | 2.3 | | 2.2 | | | | 2.4 | | 2.8 | 1.8 |
| 9 | 1.5 | | | | | 2.8 | | 2.5 | | 2.7 | | |
| 10 | | 1.5 | 2.3 | 1.5 | 2.2 | | 2.9 | | | | 2.8 | |
| 11 | 1.5 | | | | | | | 2.5 | 2.5 | 2.7 | | 1.7 |
| 12 | | | | 1.6 | 2.2 | 2.8 | 2.9 | | | | | |
| 13 | 1.5 | 1.5 | 2.4 | | | | | | 2.5 | 2.7 | 2.8 | 1.7 |
| 14 | | | | 1.6 | | 2.8 | 2.9 | 2.7 | | | | |
| 15 | | 1.5 | 2.5 | | 2.2 | | | | 2.5 | | 2.8 | 1.7 |
| 16 | 1.5 | | | | | 2.9 | | 2.7 | | 2.8 | | |
| 17 | | 1.5 | 2.6 | 1.6 | 2.2 | | 2.8 | | | | 2.8 | |
| 18 | 1.6 | | | | | | | 2.6 | 2.6 | 2.8 | | 1.7 |
| 19 | | | | 1.6 | 2.2 | 2.9 | 2.7 | | | | | |
| 20 | 1.5 | 1.6 | 2.4 | | | | | | 2.6 | 2.8 | 2.6 | 1.7 |
| 21 | | | | 1.6 | | 2.9 | 2.7 | 2 5 | | | | |
| 22 | | 1.6 | 2.0 | | 2.5 | | | | 2.6 | | 2.6 | 1.7 |
| 23 | 1.5 | | | | | 2.9 | | 2.5 | | 2.9 | | |
| 24 | | 2.0 | 1.5 | 1.6 | | | 2.7 | | | | 2.5 | |
| 25 | 1.5 | | | | | | | 2.5 | 2.6 | 2.9 | | 1.7 |
| 26 | | | | 1.5 | 2.6 | 2.9 | 2.8 | | | | | |
| 27 | 1.5 | 1.9 | 1.5 | | | | | | 2.6 | 2.9 | 2.5 | 1.7 |
| 28 | | | | 2.1 | | 2.7 | 2.8 | 2.4 | | | | |
| 29 | | | 1.5 | | 2.7 | | | | 2.5 | | 2.5 | 1.7 |
| 30 | 1.5 | | | | | 2.8 | | 2.4 | | 2.8 | | |
| 31 | | | 1.5 | | 2.8 | | 2.5 | | | | | |

## OWENS RIVER NEAR CITRUS, CAL.

This station was established October 30, 1903, by R. S. Hawley. It is located at the county bridge 4 miles east of Independence, Cal., and 1 mile from the Southern Pacific Railroad station at Citrus, Cal. The station at this point shows the amount of waste water which is discharged into Owens Lake.

The channel is straight for 200 feet above and for 300 feet below the station. The current has a mean velocity of about 2 feet per second at ordinary stages. Both banks are high and are not liable to overflow. The bed of the stream is sandy and is liable to shift.

Discharge measurements are made by means of a cable and car located about 1,500 feet above the bridge. The cable has a span of 120 feet.

The gage is a vertical rod nailed to a pile on the upstream side of the middle pier of the bridge. During 1905 the gage was read by Milton Levy. The bench mark is a copper tack in the floor beam directly over the gage rod; elevation, 13.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 222; 134, p 248.
Discharge: 100, p 223; 134, p 249.
Discharge, monthly: 134, p 251.
Gage heights: 100, p 223; 134, pp 249–250.
Rating table: 134, p. 251.

*Discharge measurements of Owens River near Citrus, Cal., in 1905.*

| Date | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 2 | R. J. Taylor | 73 | 176 | 2.21 | 6.00 | 389 |
| May 29 | J. S. Evans | 47 | 40 | 1.52 | 3.60 | 61 |
| July 21 | do | 68 | 68 | 1.84 | 4.30 | 125 |
| August 23 | do | 24 | 15.2 | .80 | 3.00 | 12.1 |
| September 20 | do | 25 | 20 | 1.05 | 3.15 | 12 |
| November 8 | F. R. S. Buttemer | 71 | 91 | 1.98 | 4.65 | 180 |
| December 3 | do | 73 | 131 | 2.21 | 5.20 | 290 |
| December 15 | do | 72 | 128 | 2.20 | 5.30 | 282 |

*Daily gage height, in feet, of Owens River near Citrus, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 5.85 | | | | 5.6 | | | 3.5 | 4.6 | 5.15 |
| 2 | | 6.0 | | | | | 5.35 | | | 3.45 | 4.65 | 5.2 |
| 3 | | 6.8 | | | | | 5.0 | | | 3.45 | 4.7 | 5.3 |
| 4 | | 6.8 | 5.8 | | | | 5.0 | | | 3.5 | 4.75 | 5.35 |
| 5 | | | | | | | 5.0 | | | 3.55 | 4.8 | 5.35 |
| 6 | 5.7 | 6.9 | 5.8 | 5.0 | | | 5.0 | | | 3.5 | 4.8 | 5.4 |
| 7 | 5.65 | 6.8 | | | | | 5.0 | | | 3.5 | 4.8 | 5.4 |
| 8 | 5.65 | 6.85 | 5.75 | | | | 5.5 | | | 3.6 | 4.85 | 5.35 |
| 9 | | 6.8 | 5.45 | | | | 5.1 | | | 3.8 | 4.85 | 5.4 |
| 10 | | 6.85 | 5.4 | | | | 5.1 | | | 3.85 | 4.9 | 5.4 |
| 11 | | 6.9 | 5.45 | | | | 5.2 | | | 3.9 | 4.9 | 5.4 |
| 12 | | 6.9 | 5.4 | | | | 5.25 | | | 3.9 | 4.9 | 5.35 |
| 13 | | | 5.7 | | | | 5.3 | | | 4.0 | 4.9 | 5.4 |
| 14 | 5.7 | 7.1 | | 4.5 | | | 5.3 | | | 4.1 | 4.95 | 5.4 |
| 15 | 5.8 | 7.15 | 5.8 | | | | 5.3 | | | 4.15 | 4.95 | 5.4 |
| 16 | | 7.2 | 6.3 | | | | 5.3 | | | 4.15 | 5.0 | 5.4 |
| 17 | | 7.2 | 6.4 | | | | 5.0 | | 3.1 | 4.2 | 5.0 | 5.5 |
| 18 | | | | | | | 4.8 | | 3.1 | 4.25 | 5.0 | 5.45 |
| 19 | 5.8 | | | | | | 4.75 | | 3.2 | 4.3 | 5.0 | 5.4 |
| 20 | 5.9 | | | | | | 4.6 | | 3.3 | 4.3 | 5.0 | 5.5 |
| 21 | 5.85 | 5.8 | | | | | 4.4 | | 3.3 | 4.4 | 5.0 | 5.4 |
| 22 | | 5.8 | | | | | 4.1 | | 3.3 | 4.4 | 5.0 | 5.45 |
| 23 | 6.0 | 5.8 | | | | 6.0 | 3.5 | | 3.3 | 4.5 | 5.0 | 5.5 |
| 24 | | | | | | 6.1 | 3.2 | | 3.2 | 4.5 | 5.0 | 5.5 |
| 25 | | | | | | 6.3 | 3.0 | | 3.25 | 4.4 | 5.0 | 5.45 |
| 26 | 6.0 | 5.8 | | | | 6.4 | 2.8 | | 3.3 | 4.45 | 5.0 | 5.45 |
| 27 | 6.0 | | | | | 6.35 | 2.75 | | 3.35 | 4.5 | 5.0 | 5.4 |
| 28 | | | | | | 6.0 | 2.6 | | 3.4 | 4.5 | 5.0 | 5.5 |
| 29 | | | | | | 5.6 | 2.5 | | 3.4 | 4.5 | 5.0 | 5.4 |
| 30 | 5.8 | | | | | 5.6 | | | 3.45 | 4.55 | 5.0 | 5.45 |
| 31 | | | | | | | | | | 4.6 | | 5.45 |

*Station rating table for Owens River near Citrus, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.50 | 0 | 3.70 | 63 | 4.90 | 217 | 6.10 | 440 |
| 2.60 | 1 | 3.80 | 73 | 5.00 | 233 | 6.20 | 462 |
| 2.70 | 3 | 3.90 | 83 | 5.10 | 249 | 6.30 | 485 |
| 2.80 | 5 | 4.00 | 94 | 5.20 | 266 | 6.40 | 508 |
| 2.90 | 8 | 4.10 | 105 | 5.30 | 283 | 6.50 | 532 |
| 3.00 | 12 | 4.20 | 117 | 5.40 | 301 | 6.60 | 556 |
| 3.10 | 18 | 4.30 | 130 | 5.50 | 319 | 6.70 | 581 |
| 3.20 | 24 | 4.40 | 144 | 5.60 | 337 | 6.80 | 607 |
| 3.30 | 31 | 4.50 | 158 | 5.70 | 356 | 6.90 | 634 |
| 3.40 | 38 | 4.60 | 172 | 5.80 | 376 | 7.00 | 662 |
| 3.50 | 46 | 4.70 | 187 | 5.90 | 397 | 7.10 | 690 |
| 3.60 | 54 | 4.80 | 202 | 6.00 | 418 | 7.20 | 720 |

NOTE.—The above table is based on 11 discharge measurements made during 1904–5. It is fairly well defined between gage heights 3 feet and 7 feet.

*Estimated monthly discharge of Owens River near Citrus, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January [a] | 418 | 283 | 369 | 22,690 |
| February [a] | 720 | 376 | 540 | 29,990 |
| March 1–17 [a] | 508 | 301 | 372 | 12,540 |
| June 23–30 | 508 | 337 | 430 | 6,823 |
| July | 337 | 0 | 175 | 10,760 |
| September 17–30 | 42 | 18 | 29.9 | 830 |
| October | 172 | 42 | 107 | 6,579 |
| November | 233 | 172 | 219 | 13,030 |
| December | 319 | 292 | 301 | 18,510 |
| The period | | | | 121,800 |

[a] Missing gage heights interpolated.

## POWERS CANAL NEAR BISHOP, CAL.

This station was established August 19, 1903, by R. S. Hawley. It is located one-half mile above a mill on Bishop Creek, and 4½ miles west of Bishop, Cal.

The canal is straight for 20 feet above and 50 feet below the station. The bed of the canal is composed of gravel and is not subject to change.

Discharge measurements are made by wading.

The gage is a rod on the left bank of the canal. The bench mark is on granite bowlder 60 feet north of penstock of the mill pressure pipe; elevation, 3.50 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, pp 251-252.
Discharge: 134, p 252.
Discharge, monthly: 134, p 253.
Gage heights: 134, p 252.
Rating table: 134, p 252.

*Discharge measurements of Powers canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 3 | J. S. Evans | 3 | 0.7 | 1.00 | 1.10 | 0.7 |
| June 21 | .....do | 9 | 6.4 | 2.66 | 1.90 | 17.0 |
| July 27 | .....do | 8 | 5.0 | 2.36 | 1.68 | 11.8 |
| August 10 | .....do | 7 | 1.3 | 1.08 | 1.30 | 1.4 |
| September 7 | .....do | 7.5 | 2.1 | 1.33 | 1.40 | 2.8 |
| November 23 | F. R. S. Buttemer | 8 | 1.4 | .79 | 1.25 | 1.1 |
| December 11 | .....do | 8 | 3.6 | .89 | 1.58 | 3.2 |
| December 21 | .....do | ...... | .......... | ........... | 1.16 | 1.0 |

### SOUTH HILLSIDE CANAL NEAR BISHOP, CAL.

This station was established August 26, 1903, by R. S. Hawley. It is located just below waste gate at head of canal, 5 miles west of Bishop, Cal.

Discharge measurements are made by wading.

The gage is a rod on the left bank of the canal. The bench mark is on granite bowlder marked by ring of white paint and located on left bank 2 feet from gage; elevation, 2.99 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 253.
Discharge: 134, p 253.
Discharge, monthly: 134, p 255.
Gage heights: 134, p 254.
Rating table: 134, p 254.

*Discharge measurements of South Hillside canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 21 | R. J. Taylor | 4.5 | 0.9 | 1.11 | 1.60 | 1.0 |
| February 8 | .....do | 4.5 | .9 | 1.11 | 1.60 | 1.0 |
| March 4 | .....do | 4.5 | 1.3 | 1.46 | 1.66 | 1.9 |
| April 18 | J. S. Evans | 4.8 | 1.6 | 1.88 | 1.70 | 3.0 |
| May 5 | .....do | 4.8 | 3.2 | 2.66 | 2.00 | 8.5 |
| July 27 | .....do | 4.5 | 2.4 | 3.29 | 1.98 | 7.9 |
| August 10 | .....do | 5.0 | 3.6 | 2.47 | 2.00 | 8.9 |
| September 22 | .....do | 4.5 | 3.2 | 2.75 | 2.00 | 8.8 |
| October 25 | F. R. S. Buttemer | 4.0 | 2.0 | 1.75 | 1.75 | 3.5 |
| November 23 | .....do | 5.0 | 1.0 | .90 | 1.58 | .9 |
| December 11 | .....do | 3.7 | .6 | .50 | 1.50 | .3 |

## NORTH HILLSIDE CANAL NEAR BISHOP, CAL.

This station was established September 3, 1903, by R. S. Hawley. It is located at head gate of the canal, 5 miles west of Bishop, Cal.

Discharge measurements are made from crosspiece of the flume on which the distances across are marked at each foot. The initial point for soundings is the end of crosspiece of flume at right bank.

The gage is a vertical rod fastened to the right side of flume or head gate. The bench mark is on a granite bowlder marked with white paint and located near gage; elevation, 2.96 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 255.
Discharge: 134, p 255.
Discharge, monthly: 134, p 256.
Gage heights: 134, p 256.
Rating table: 134, p 256.

*Discharge measurements of North Hillside Canal near Bishop, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 4 | R. J. Taylor | 4.3 | 1.8 | 0.83 | 1.51 | 1.5 |
| April 18 | J. S. Evans | 4 | 2.2 | 2.23 | 1.70 | 4.9 |
| May 5 | do | 4 | 3.6 | 3.33 | 2.00 | 12.0 |
| June 21 | do | 4 | 3.0 | 7.67 | 2.10 | 23.0 |
| July 27 | do | 4 | 2.4 | 7.83 | 2.05 | 18.8 |
| August 10 | do | 4 | 2.6 | 7.46 | 2.08 | 19.4 |
| September 17 | do | 4 | 3.2 | 3.70 | 1.98 | 11.8 |
| September 22 | do | 4.2 | 2.5 | 5.20 | 2.0 | 13.0 |
| October 23 | do | 4.0 | 2.0 | 1.95 | 1.70 | 3.9 |
| November 23 | do | 6 | 2.4 | 1.21 | 1.70 | 2.9 |
| December 11 | do | 4.3 | 2.2 | .32 | 1.52 | .7 |
| December 21 | F. R. S. Buttemer | 4.5 | .8 | .75 | 1.45 | .6 |

## BIG PINE CREEK NEAR BIG PINE, CAL.

This station was established December 5, 1903, by R. S. Hawley. It is located 3 miles southwest of Big Pine, Cal., at a point where the creek leaves the foothills.

The channel is straight for 30 feet above and 50 feet below the station. The current is swift at all stages. Both banks are high and rocky. The bed of the stream is rough and rocky, and is not subject to much change.

Discharge measurements are made from a footbridge. The initial point is at the right bank.

The gage is a veritical rod fastened to a tree on the left bank of the creek, 3 feet above the footbridge. During 1905 the gage was read by Mrs. J. M. Randle. Bench marks were established as follows: (1) On a granite bowlder marked by a ring of white paint, 40 feet southeast of the south end of the footbridge; elevation, 8.54 feet; (2) a point marked with a ring of white paint, 45 feet southwest of the south end of the footbridge; elevation, 10.44 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 134, p 257.
Discharge: 134, pp 257, 260.
Discharge, monthly: 134, p 259.
Gage heights: 134, p 258.
Rating table: 134, p 258.

*Discharge measurements of Big Pine Creek near Big Pine, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 18 | R. J. Taylor | 13 | 9.9 | 2.52 | 1.95 | 25 |
| February 18 | do | 12.5 | 8.5 | 2.71 | 1.85 | 23 |
| April 26 | J. S. Evans | 13 | 10.8 | 2.78 | 2.20 | 30 |
| May 19 | do | 13 | 13.8 | 3.70 | 2.38 | 51 |
| June 9 | do | 13 | 15.8 | 3.86 | 2.48 | 61 |
| July 16 | do | 13.5 | 21.0 | 5.71 | 2.85 | 120 |
| August 17 | do | 13 | 18.4 | 4.77 | 2.60 | 88 |
| September 13 | do | 13 | 13.0 | 3.15 | 2.30 | 41 |
| November 16 | F. R. S. Buttermer | 10 | 6.6 | 1.61 | 1.85 | 10.6 |
| December 1 | do | 13.5 | 8.8 | 1.62 | 2.00 | 14.3 |
| December 16 | do | 13.5 | 12.6 | 0.83 | 2.20 | 10.5 |
| December 16 | do | 13.5 | 12.5 | 0.98 | 2.20 | 12.2 |

[a] Channel changed.

*Daily gage height, in feet, of Big Pine Creek near Big Pine, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.85 | 1.9 | 1.85 | 1.8 | 2.5 | 2.4 | 2.95 | 2.9 | 2.7 | 2.25 | 1.8 | |
| 2 | 1.85 | 1.9 | 1.9 | 1.9 | 2.5 | 2.4 | 3.0 | 2.9 | 2.6 | 2.15 | | 1.9 |
| 3 | 1.85 | 1.9 | 1.9 | 1.85 | 2.5 | 2.4 | 3.0 | 2.9 | 2.5 | 2.15 | | |
| 4 | 1.85 | 2.0 | 1.9 | 1.9 | 2.5 | 2.4 | 3.0 | 2.9 | 2.4 | 2.15 | | 1.9 |
| 5 | 1.85 | 2.0 | 1.9 | 1.9 | 2.4 | 2.4 | 3.0 | 2.9 | 2.4 | 2.1 | | |
| 6 | 1.85 | 2.0 | 1.9 | 1.85 | 2.4 | 2.45 | 3.0 | 2.9 | 2.35 | 2.0 | | |
| 7 | 1.85 | 1.95 | 1.9 | 1.85 | 2.4 | 2.45 | 3.0 | 2.8 | 2.25 | 2.0 | | |
| 8 | 1.85 | 1.95 | 1.9 | 1.9 | 2.3 | 2.5 | 3.0 | 2.8 | 2.25 | 2.0 | 1.8 | |
| 9 | 1.9 | 1.9 | 1.9 | 1.95 | 2.0 | 2.5 | 3.2 | 2.9 | 2.2 | 2.0 | | 1.9 |
| 10 | 1.9 | 1.9 | 1.85 | 1.95 | 2.0 | 2.5 | 3.5 | 3.0 | 2.3 | 2.0 | | |
| 11 | 1.85 | 1.9 | 1.85 | 1.95 | 2.0 | 2.7 | 3.5 | 3.0 | 2.4 | 2.0 | 1.85 | 2.0 |
| 12 | 1.8 | 1.9 | 1.9 | 1.95 | 2.0 | 2.8 | 3.5 | 3.0 | 2.4 | 2.0 | | |
| 13 | 1.8 | 1.9 | 1.9 | 1.95 | 2.1 | 2.9 | 3.3 | 2.9 | 2.45 | 2.0 | | |
| 14 | 1.8 | 1.9 | 1.9 | 1.95 | 2.2 | 2.9 | 3.3 | 2.9 | 2.45 | 2.0 | | |
| 15 | 1.8 | 1.85 | 1.9 | 1.95 | 2.3 | 2.9 | 3.3 | 2.9 | 2.45 | 1.85 | 1.85 | 2.0 |
| 16 | 1.85 | 1.85 | 1.9 | 1.95 | 2.3 | 2.9 | 3.05 | 2.9 | 2.45 | 1.85 | | |
| 17 | 1.85 | 1.85 | 1.9 | 1.95 | 2.3 | 2.95 | 3.2 | 2.9 | 2.35 | 1.8 | | |
| 18 | 1.85 | 1.85 | 1.9 | 1.95 | 2.4 | 3.0 | 3.1 | 2.8 | 2.4 | 1.8 | 1.8 | |
| 19 | 1.85 | 1.85 | 1.9 | 1.95 | 2.4 | 3.0 | 3.0 | 2.8 | 2.45 | 1.8 | | |
| 20 | 1.85 | 1.85 | 1.9 | 1.95 | 2.4 | 3.0 | 3.0 | 2.9 | 2.45 | 1.8 | | 2.2 |
| 21 | 1.85 | 1.85 | 1.9 | 1.95 | 2.5 | 3.2 | 3.0 | 2.8 | 2.4 | 1.8 | | |
| 22 | 1.8 | 1.85 | 1.9 | 1.95 | 2.5 | 3.3 | 3.0 | 2.8 | 2.4 | 1.8 | | |
| 23 | 1.85 | 1.85 | 1.9 | 2.0 | 2.4 | 3.4 | 3.1 | 2.7 | 2.4 | 1.8 | 1.85 | 2.15 |
| 24 | 1.85 | 1.85 | 1.9 | 2.0 | 2.4 | 3.2 | 3.2 | 2.7 | 2.35 | 1.8 | | |
| 25 | 1.85 | 1.85 | 1.9 | 2.0 | 2.4 | 2.8 | 3.3 | 2.7 | 2.3 | 1.8 | | |
| 26 | 1.85 | 1.85 | 1.9 | 2.2 | 2.4 | 2.8 | 3.4 | 2.7 | 2.3 | 1.8 | | 2.3 |
| 27 | 1.85 | 1.85 | 1.9 | 2.3 | 2.4 | 2.8 | 3.3 | 2.7 | 2.3 | 1.8 | | |
| 28 | 1.85 | 1.85 | 1.8 | 2.3 | 2.4 | 2.9 | 3.2 | 2.7 | 2.3 | 1.8 | 1.85 | |
| 29 | 1.85 | | 1.8 | 2.4 | 2.4 | 2.9 | 3.1 | 2.7 | 2.3 | 1.8 | | |
| 30 | 1.85 | | 1.8 | 2.5 | 2.4 | 2.9 | 3.1 | 2.7 | 2.3 | 1.8 | | |
| 31 | 1.85 | | 1.8 | | 2.4 | | 3.0 | 2.7 | | 1.8 | | |

*Station rating table for Big Pine Creek near Big Pine, Cal., from March 21 to December 15, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 9 | 2.30 | 40 | 2.80 | 115 | 3.30 | 220 |
| 1.90 | 11 | 2.40 | 52 | 2.90 | 134 | 3.40 | 244 |
| 2.00 | 15 | 2.50 | 66 | 3.00 | 154 | 3.50 | 268 |
| 2.10 | 21 | 2.60 | 81 | 3.10 | 175 | | |
| 2.20 | 30 | 2.70 | 97 | 3.20 | 197 | | |

NOTE.—The above table is based on eight discharge measurements made during 1905. It is fairly well defined between gage heights 2 feet and 2.8 feet. The table has been extended beyond these limits, being based on extension of area and mean-velocity curves.

*Estimated monthly discharge of Big Pine Creek near Big Pine, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 24 | 19 | 21.7 | 1,334 |
| February | 30 | 22 | 23.9 | 1,327 |
| March | 24 | 9 | 18.9 | 1,162 |
| April | 66 | 9 | 17.9 | 1,065 |
| May | 66 | 15 | 46.7 | 2,872 |
| June | 244 | 52 | 118 | 7,021 |
| July | 268 | 144 | 187 | 11,500 |
| August | 154 | 97 | 122 | 7,501 |
| September | 97 | 30 | 51.1 | 3,041 |
| October | 35 | 9 | 13.7 | 842 |
| November | 10 | 9 | 9.6 | 571 |
| December 1-15 | 15 | 11 | 12.5 | 372 |
| The period | | | | 38,610 |

NOTE.—Discharge January 1 to March 20 based on discharge measurements directly. Rating table used March 21 to December 15. Because of a change in channel the rating table does not apply after December 15.

Discharges for days in November and December, when gage heights are not recorded, were interpolated.

### BIRCH CREEK NEAR TINEMAHA, CAL.

This station was established June 14, 1905, by J. S. Evans. It is located 6 miles southwest of Big Pine and 500 feet west of ranch of Charles Peterson.

The channel is straight for 25 feet above and below the station. The water is swift at all stages. Both banks are low, but not subject to overflow. The bed of the stream is composed of coarse gravel and is not subject to material change. The stream flows in one channel.

Discharge measurements are made from a footbridge, which consists of a cottonwood tree placed across the stream. The initial point for soundings is a nail in footbridge on the left bank.

The gage is a vertical staff nailed to a willow tree on the left bank. During 1905 the gage was read by Charles Peterson. The bench mark is a nail in the top of a willow stump on the left bank; elevation, 2.00 feet above the datum of the gage.

*Discharge measurements of Birch Creek near Tinemaha, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 14 | J. S. Evans | 7 | 9.6 | 2.19 | 1.00 | 21 |
| July 17 | do | 8 | 8.0 | 1.35 | .71 | 10.8 |
| August 24 | do | 8 | 7.6 | 1.00 | .58 | 7.6 |
| November 17 | F. R. S. Buttemer | 8 | 6.2 | .35 | .55 | 2.2 |
| December 2 | do | 8 | 6.0 | .42 | .55 | 2.5 |

*Daily gage height, in feet, of Birch Creek near Tinemaha, Cal., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | | 0.8 | 0.65 | 0.6 | 0.5 | 0.35 | 0.8 |
| 2 | | .75 | .65 | .55 | .4 | .35 | .55 |
| 3 | | .75 | .65 | .6 | .4 | .35 | .55 |
| 4 | | .8 | .65 | .55 | .35 | .45 | .55 |
| 5 | | .8 | .6 | .55 | .35 | .5 | .5 |
| 6 | | .8 | .55 | .5 | .3 | .5 | .5 |
| 7 | | .85 | .6 | .5 | .3 | .5 | .5 |
| 8 | | .9 | .65 | .45 | .3 | .5 | .5 |
| 9 | | .9 | .75 | .45 | .35 | .5 | .5 |
| 10 | | .85 | .8 | .5 | .35 | .5 | |
| 11 | | .9 | .65 | .5 | .35 | .5 | |
| 12 | | .9 | .6 | .5 | .35 | .5 | |
| 13 | | .85 | .6 | .45 | .35 | .5 | |
| 14 | 1.0 | .75 | .6 | .45 | .35 | .5 | |
| 15 | | .7 | .6 | .45 | .35 | .5 | |
| 16 | | .7 | .55 | .4 | .35 | .5 | |
| 17 | | .7 | .55 | .4 | .35 | .5 | |
| 18 | .9 | .7 | .55 | .4 | .35 | .5 | |
| 19 | .9 | .65 | .5 | .4 | .35 | .5 | |
| 20 | .9 | .65 | .6 | .4 | .35 | .5 | |
| 21 | .8 | .65 | .65 | .4 | .35 | .5 | |
| 22 | 1.0 | .65 | .65 | .4 | .35 | .5 | |
| 23 | .8 | .7 | .55 | .4 | .35 | .5 | |
| 24 | .9 | .7 | .55 | .4 | .35 | .5 | |
| 25 | .75 | .75 | .55 | .4 | .35 | .5 | |
| 26 | .75 | .8 | .55 | .4 | .35 | .5 | |
| 27 | .75 | .8 | .6 | .4 | .35 | .5 | |
| 28 | .75 | .75 | .6 | .4 | .35 | .65 | |
| 29 | .8 | .7 | .65 | .45 | .35 | .7 | |
| 30 | .85 | .65 | .65 | .45 | .35 | .6 | |
| 31 | | .65 | .65 | | .35 | | |

## INDEPENDENCE CREEK NEAR INDEPENDENCE, CAL.

This station was established June 15, 1905, by J. S. Evans. It is located about 1 mile west of the town of Independence near intake of the city waterworks of Independence.

The channel is straight for 25 feet above and below the gaging station. Both banks are low, but not subject to overflow. The bed of the stream is composed of gravel and rocks. The approximate depth of water is 1.2 feet. The stream discharges in one channel.

Discharge measurements are made by wading. The initial point for soundings is on the right bank.

The gage is a vertical timber nailed to a willow tree on the right bank. During 1905 the gage was read by Milton Levy. The bench mark is a cross on large rock on right bank of the stream; elevation, 1.70 feet above the datum of the gage.

*Discharge measurements of Independence Creek near Independence, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 15 | J. S. Evans | 12 | 13.6 | 3.46 | 1.10 | 47 |
| July 21 | do | 12 | 8.0 | 2.42 | .72 | 19.4 |
| August 23 | do | 11 | 5.0 | 1.46 | .47 | 7.3 |
| November 11 | F. R. S. Buttemer | 11 | 3.9 | .79 | .35 | 3.1 |
| December 3 | do | 11 | 4.6 | .80 | .37 | 3.7 |

*Daily gage height, in feet, of Independence Creek near Independence, Cal., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | | 0.9 | 0.65 | 0.45 | 0.35 | 0.35 | 0.4 |
| 2 | | .9 | .65 | .45 | .35 | .35 | .4 |
| 3 | | .85 | .65 | .45 | .35 | .35 | .4 |
| 4 | | .85 | .6 | .45 | .35 | .35 | .4 |
| 5 | | .85 | .6 | .45 | .35 | .35 | .4 |
| 6 | | .85 | .6 | .45 | .35 | .35 | .4 |
| 7 | | .9 | .55 | .45 | .35 | .35 | .4 |
| 8 | | .85 | .55 | .45 | .35 | .35 | .35 |
| 9 | | .85 | .55 | .45 | .3 | .35 | .4 |
| 10 | | .85 | .55 | .35 | .35 | .35 | .4 |
| 11 | | .9 | .55 | .35 | .35 | .35 | .4 |
| 12 | | .9 | .55 | .35 | .35 | .35 | .3 |
| 13 | | .9 | .55 | .4 | .35 | .35 | .35 |
| 14 | | .85 | .55 | .4 | .35 | .35 | .35 |
| 15 | 1.1 | .8 | .55 | .35 | .4 | .35 | .4 |
| 16 | 1.1 | .8 | .55 | .35 | .4 | .35 | .4 |
| 17 | 1.1 | .75 | .55 | .4 | .35 | .35 | .4 |
| 18 | 1.1 | .75 | .55 | .4 | .35 | .35 | .35 |
| 19 | 1.1 | .75 | .55 | .4 | .35 | .35 | .4 |
| 20 | 1.1 | .75 | .55 | .35 | .35 | .35 | .4 |
| 21 | 1.1 | .7 | .55 | .35 | .4 | .35 | .3 |
| 22 | 1.05 | .7 | .55 | .35 | .35 | .35 | .3 |
| 23 | 1.05 | .7 | .55 | .4 | .35 | .4 | .35 |
| 24 | 1.1 | .7 | .55 | .4 | .35 | .4 | .35 |
| 25 | .95 | .7 | .55 | .35 | .35 | .4 | .3 |
| 26 | .95 | .7 | .55 | .35 | .35 | .4 | .3 |
| 27 | .95 | .7 | .5 | .35 | .35 | .4 | .3 |
| 28 | .95 | .7 | .5 | .35 | .35 | .4 | .35 |
| 29 | .9 | .7 | .5 | .35 | .35 | .4 | .35 |
| 30 | .9 | .7 | .5 | .35 | .35 | .4 | .35 |
| 31 | | .65 | .45 | | .35 | | .35 |

NOTE.—Gage heights interpolated June 16–20; October 29 to November 10; November 12 to December 2.

*Station rating table for Independence Creek near Independence, Cal., from June 15 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 1.6 | 0.60 | 12.9 | 0.80 | 24 | 1.00 | 39 |
| 0.40 | 4.8 | 0.70 | 18 | 0.90 | 31 | 1.10 | 47 |
| 0.50 | 8.5 | | | | | | |

NOTE.—The above table is based on five discharge measurements made during 1905. It is well defind between gage heights 0.4 foot and 1.1 feet.

*Estimated monthly discharge of Independence Creek near Independence, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| June 15-30 | 47 | 31 | 41.5 | 1,317 |
| July | 31 | 15.4 | 23.5 | 1,445 |
| August | 15.4 | 6.6 | 10.9 | 670 |
| September | 6.6 | 3.1 | 4.6 | 274 |
| October | 4.8 | 1.6 | 3.2 | 198 |
| November | 4.8 | 3.1 | 3.6 | 214 |
| December | 4.8 | 1.6 | 3.6 | 223 |
| The period | | | | 4,341 |

## OAK CREEK NEAR INDEPENDENCE, CAL.

This station was established June 15, 1905, by J. S. Evans. It is located about 1 mile west of old Fort Independence and 3 miles northwest of the town of Independence.

The channel is straight for a short distance above and below the station. Both banks are low and subject to slight overflow in high water. The bed of the stream is composed of gravel and rocks, with high velocity at all stages. The stream flows in one channel and has an average depth of 1.2 feet.

Discharge measurements are usually made by wading, although a plank placed across the stream is used as a footbridge for higher stages of the water. The initial point for soundings is a nail in the footbridge on the left bank.

The gage is a staff nailed to a stake driven on the left bank of the stream. During 1905 the gage was read by A. M. Bell. The bench mark is a nail driven in the top of a stake set firmly in the ground on the right bank of the stream near the end of the footbridge; elevation, 1.30 feet above the datum of the gage.

*Discharge measurements of Oak Creek near Independence, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 15 | J. S. Evans | 6 | 8.4 | 3.81 | 1.10 | 32 |
| July 17 | do | 5 | 4.4 | 4.00 | .63 | 17.6 |
| August 23 | do | 5 | 2.8 | 4.18 | .30 | 11.7 |
| November 8 | F. R. S. Buttemer | 5 | 3.4 | 3.24 | .35 | 11.0 |
| December 4 | do | 6 | 3.1 | 1.87 | .25 | 5.8 |

*Daily gage height, in feet, of Oak Creek near Independence, Cal., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.0 | 0.6 | 0.4 | 0.3 | 0.3 | 0.3 |
| 2 | ........ | 1.0 | .5 | .4 | .3 | .3 | .3 |
| 3 | ........ | 1.0 | .5 | .4 | .3 | .3 | .25 |
| 4 | ........ | .9 | .5 | .4 | .3 | .3 | .25 |
| 5 | ........ | 1.0 | .5 | .4 | .2 | .3 | .3 |
| 6 | ........ | 1.0 | .5 | .3 | .2 | .4 | .3 |
| 7 | ........ | 1.0 | .5 | .3 | .2 | .4 | .25 |
| 8 | ........ | 1.0 | .5 | .3 | .3 | .3 | .25 |
| 9 | ........ | 1.0 | .5 | .3 | .3 | .4 | .25 |
| 10 | ........ | 1.1 | .5 | .3 | .3 | .3 | .25 |
| 11 | ........ | 1.1 | .5 | .3 | .3 | .3 | .25 |
| 12 | ........ | 1.1 | .5 | .3 | .3 | .3 | .25 |
| 13 | ........ | 1.0 | .5 | .3 | .3 | .3 | .3 |
| 14 | ........ | .9 | .4 | .3 | .2 | .3 | .3 |
| 15 | ........ | .9 | .4 | .3 | .3 | .3 | .3 |
| 16 | ........ | .8 | .4 | .2 | .2 | .3 | .3 |
| 17 | ........ | .8 | .4 | .2 | .2 | .3 | .25 |
| 18 | 1.3 | .7 | .4 | .2 | .3 | .3 | .25 |
| 19 | 1.3 | .7 | .4 | .2 | .3 | .3 | .25 |
| 20 | 1.3 | .6 | .4 | .2 | .3 | .3 | .25 |
| 21 | 1.4 | .7 | .4 | .2 | .3 | .3 | .25 |
| 22 | 1.2 | .6 | .4 | .2 | .3 | .3 | .25 |
| 23 | 1.2 | .6 | .4 | .2 | .3 | .3 | .25 |
| 24 | 1.1 | .7 | .4 | .2 | .3 | .3 | .25 |
| 25 | 1.0 | .7 | .4 | .2 | .3 | .3 | .25 |
| 26 | 1.0 | .7 | .4 | .2 | .3 | .3 | .25 |
| 27 | 1.0 | .7 | .4 | .2 | .3 | .3 | .25 |
| 28 | .9 | .7 | .4 | .2 | .3 | .3 | .25 |
| 29 | 1.0 | .6 | .4 | .2 | .3 | .3 | .25 |
| 30 | 1.0 | .6 | .4 | .3 | .3 | .3 | .25 |
| 31 | ........ | .6 | .4 | ........ | .3 | ........ | .25 |

## MISCELLANEOUS MEASUREMENTS IN OWENS RIVER DRAINAGE BASIN.

The following is a list of the miscellaneous discharge measurements made in the Owens River drainage basin during 1905:

*Ash Creek near Lone Pine, Cal.*—This stream discharges into Owens Lake from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 19: Width, 10 feet; area, 5.4 square feet; mean velocity, 1.96 feet per second; discharge, 10.6 second-feet.

July 19: Width, 4 feet; area, 1 square foot; mean velocity, 1.80 feet per second; discharge, 1.8 second-feet.

*Birch Creek near Bishop, Cal.*—This stream is tributary to Owens River above Bishop, Cal. A measurement was made August 1, 1905, by J. S. Evans at the point where the stream leaves the foothills and enters the valley.

Width, 6 feet; area, 4.4 square feet; mean velocity. 2.72 feet per second; discharge, 12 second-feet.

*Clear Creek near Big Pine, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 7 feet; area, 5.6 square feet; mean velocity, 1.86 feet per second; discharge, 10.4 second-feet.

July 17: Width, 6 feet; area, 3.4 square feet; mean velocity, 1.61 feet per second; discharge, 5.5 second-feet.

*Cottonwood Creek near Olancha, Cal.*—This stream discharges into Owens Lake from the eastern slope of the Sierra Nevada. The gage rod is a 1 by 3 inch timber graduated to feet and tenths and nailed to a cottonwood tree on the right bank of the stream. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 16: Width, 28 feet; area, 30 square feet; mean velocity, 3.03 feet per second; gage height, 0.80 foot; discharge, 91 second-feet.

July 20: Width, 20 feet; area, 16.2 square feet; mean velocity, 1.86 feet per second; gage height, 0.33 foot; discharge, 30 second-feet.

November 10: Width, 8 feet; area, 5 square feet; mean velocity, 0.86 foot per second; discharge, 4.3 second-feet.

*Division Creek near Independence, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following discharge measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 4 feet; area, 1.9 square feet; mean velocity, 1.74 feet per second; discharge, 3.3 second-feet.

July 17: Width, 4 feet; area, 1.2 square feet; mean velocity, 1.75 feet per second; discharge, 2.1 second-feet.

December 2: Width, 6.5 feet; area, 2.9 square feet; mean velocity, 1.86 feet per second; discharge, 5.4 second-feet.

*Eight Mile Creek near Independence, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made December 4, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 4.5 feet; area, 2.2 square feet; mean velocity, 1.45 feet per second; discharge, 3.2 second-feet.

*Fish Springs near Big Pine, Cal.*—A measurement was made of the water discharging from these springs on December 4, 1905:

Width, 7 feet; area, 20 square feet; mean velocity, 1.45 feet per second; discharge, 29 second-feet.

*Goodale Creek near Tibbetts, Cal.*—This stream is a tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 4.5 feet; area, 2.6 square feet; mean velocity, 2.27 feet per second; discharge, 5.9 second-feet.

July 17: Width, 3.5 feet; area, 1.8 square feet; mean velocity, 1.94 feet per second; discharge, 3.5 second-feet.

August 22: Width, 3 feet; area, 1.5 square feet; mean velocity, 2.26 feet per second; discharge, 3.4 second-feet.

November 17: Width, 3.7 feet; area, 2.2 square feet; mean velocity, 2.09 feet per second; discharge, 4.6 second-feet.

*Georges Creek near Independence, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made June 15, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 11 feet; area, 9.2 square feet; mean velocity, 2.61 feet per second; discharge, 24 second-feet.

*Lone Pine Creek near Lone Pine, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 15: Width, 13 feet; area, 14.2 square feet; mean velocity, 2.61 feet per second; discharge, 37 second-feet.

July 19: Width, 13 feet; area, 13 square feet; mean velocity, 2.31 feet per second; discharge, 30 second-feet.

November 9: Width, 12.5 feet; area, 4.2 square feet; mean velocity, 0.83 foot per second; discharge, 3.5 second-feet.

*Moffett Creek near Independence, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made on June 15 at a point where the stream leaves the foothills and enters the valley:

Width, 7 feet; area, 4 square feet; mean velocity, 2.25 feet per second; discharge, 9 second-feet.

*McGee Creek near Bishop, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. A measurement was made on August 1, 1905, at a point where the stream leaves the foothills and enters the valley:

Width, 4 feet; area, 4 square feet; mean velocity, 2.18 feet per second; discharge, 8.7 second-feet.

*Shepherds Creek near Independence, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 15: Width, 6 feet; area, 6 square feet; mean velocity, 2.53 feet per second; discharge, 15.2 second-feet.

July 18: Width, 6 feet; area, 2.7 square feet; mean velocity, 2.37 feet per second; discharge, 6.4 second-feet.

*Taboose Creek near Tibbetts, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The gage rod is a 1 by 3 inch timber graduated to feet and tenths and nailed to a willow tree on the left bank of the stream. The bench mark is a nail in willow tree on the left bank, to which gage is fastened. Its elevation is 1.60 feet above the zero of the gage. The following measurements were made during 1905 at a point where the stream leaves the foothills and enters the valley:

June 14: Width, 10 feet; area, 10.6 square feet; mean velocity, 1.68 feet per second; gage height, 0.60 foot; discharge, 17.8 second-feet.

July 17: Width, 10 feet; area, 6.6 square feet; mean velocity, 1.82 feet per second; gage height, 0.40 foot; discharge, 12 second-feet.

August 24: Width, 10 feet; area, 3 square feet; mean velocity, 1.67 feet per second; gage height, 0.10 foot; discharge, 5 second-feet.

November 17: Width, 7 feet; area, 3.8 square feet; mean velocity, 1 foot per second; gage height, 0.10 foot; discharge, 3.8 second-feet.

December 2: Width, 7 feet; area, 4.6 square feet; mean velocity, 1 foot per second; gage height, 0.15 foot; discharge, 4.6 second-foot.

*Tuttle Creek near Lone Pine, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at the point where the stream leaves the foothills and enters the valley:

June 16: Width, 12 feet; area, 6 square feet; mean velocity, 1.80 feet per second; discharge, 10.8 second-feet.

July 19: Width, 10 feet; area, 4.5 square feet; mean velocity, 2.40 feet per second; discharge, 10.8 second-feet.

*Tinemaha Creek near Tinemaha, Cal.*—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made during 1905 at the point where the stream leaves the foothills and enters the valley:

June 14: Width, 8 feet; area, 10.5 square feet; mean velocity, 1.86 feet per second; discharge, 19.5 second-feet.

July 17: Width, 6 feet; area, 4.4 square feet; mean velocity, 3.36 feet per second; discharge, 14.8 second-feet.

December 2: Width, 7 feet; area, 5.2 square feet; mean velocity, 0.60 foot per second; discharge, 3.1 second-feet.

## MOHAVE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Mohave River rises on the northern slope of the San Bernardino Mountains, and, flowing in a northerly direction, finally disappears in the sands of the Mohave Desert. This stream has few tributaries, the only ones of importance being West Fork and Deep Creek, which have their source in the higher elevations of the San Bernardino Mountains. The formation is of granite, with good covering of soil. On the higher elevations there is a considerable growth of timber, which diminishes as one approaches the lower reaches, changing to a light growth of brush and grass, finally merging into the barren desert. During the greater portion of the year the stream bed is dry below the junction of West Fork and Deep Creek, where the waters disappear in the sand and gravelly bed of the stream. Water again rises at a point lower down on the river above Victorville, where the gaging station is located. Water is diverted above and below the gaging station, but is again returned to the river channel. There are several artesian wells along the river above the gaging station, the water being used for irrigation. This stream does not discharge in any large quantity except during an extremely heavy rainfall in the winter months. The precipitation throughout this basin is very light, with the possible exception of the higher elevation of the San Bernardino Mountains, where there is a considerable fall of snow during the winter months, which melts in the early spring.

### MOHAVE RIVER AT VICTORVILLE, CAL.

This station was established February 27, 1899, by Bert Cole. It is located in the town of Victorville, a station on the Atchison, Topeka and Santa Fe Railroad, where the Mohave River passes through a narrow gorge locally known as the "Narrows." This place has been under investigation as a possible dam site, and soundings for the depth of bed rock were made by the United States Geological Survey during the season of 1899. The greatest depth of bed rock was found to be 54 feet. The diamond drill showed the rock to be a fine granite. A more detailed account of this exploration will be found in the Twenty-first Annual Report, part 4. Above the "Narrows" the valley broadens into a large reservoir site, but as no surveys of it have been made the capacity is unknown.

The channel is straight for 300 feet above and below the section where the rod is located. Both banks are high and rocky and not subject to overflow. The channel is composed of sand, which is constantly shifting.

During medium and low stages discharge measurements are made from a low foot bridge or by wading. During floods discharge measurements are made from the county bridge. The mean estimated monthly discharge is obtained by averaging the discharge measurements made during the year.

Gage readings were discontinued in 1902. On March 1, 1905, a new inclined rod was fastened to the rock on the left bank about 300 feet above the county bridge. This gage was established as a matter of interest in connection with the discharge of the stream at high stages. There is no relation between gage readings and the discharge, as the bed of the stream is constantly changing at different stages of the river. During 1905 discharge measurements were made twice each week, and the gage was read by P. H. Leahy. The bench mark is a bolt sulphured in solid rock on the left bank, about 15 feet from the Santa Fe Railroad track and 40 feet west of the gage rod. It is 20.45 feet above the datum of the gage. Elevation, 2,726.52 feet above sea level, as established by connection with a standard United States Geological Survey bench mark at Victorville.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Mohave River at Victorville, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | Date. | Hydrographer. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Sec.-ft.* | | | *Feet* | *Sec.-ft.* |
| January 3 | P. H. Leahy | | 56 | June 27 | P. H. Leahy | | 30 |
| January 6 | do | | 58 | June 30 | do | | 35 |
| January 10 | do | | 70 | July 3 | do | | 36 |
| January 13 | do | | 71 | July 7 | do | | 32 |
| January 17 | do | | 59 | July 11 | do | | 31 |
| January 20 | do | | 59 | July 14 | do | | 27 |
| January 25 | do | | 56 | July 18 | do | | 36 |
| January 27 | do | | 53 | July 21 | do | | 32 |
| January 31 | do | | 56 | July 25 | do | | 30 |
| February 5 | do | | 822 | July 28 | do | | 34 |
| February 8 | do | | 82 | August 2 | do | | 30 |
| February 11 | do | | 90 | August 5 | do | | 29 |
| February 15 | do | | 2,032 | August 25 | do | | 36 |
| February 18 | do | | 97 | August 28 | do | | 29 |
| February 21 | do | | 95 | August 31 | do | | 35 |
| March 2 | do | 3.96 | 98 | September 1 | do | | 47 |
| March 3 | E. C. La Rue | 3.92 | 90 | September 5 | do | | 35 |
| March 6 | P. H. Leahy | 3.85 | 91 | September 8 | do | | 35 |
| March 11 | do | 3.77 | 74 | September 11 | do | | 37 |
| March 13 | do | 9.90 | 5,410 | September 15 | do | | 42 |
| March 15 | do | 4.50 | 820 | September 19 | do | | 43 |
| March 16 | O. W. Peterson | 4.95 | 2,350 | September 22 | do | | 43 |
| March 18 | P. H. Leahy | 4.06 | 980 | September 26 | do | | 42 |
| March 22 | do | 4.04 | 740 | September 29 | do | | 42 |
| March 25 | do | | 460 | October 3 | do | | 40 |
| March 27 | do | 4.0 | 340 | October 6 | do | | 49 |
| March 31 | do | 3.91 | 290 | October 10 | do | | 41 |
| April 6 | R. S. Hawley | 3.75 | 133 | October 13 | do | | 44 |
| April 8 | P. H. Leahy | 3.75 | 133 | October 17 | do | | 44 |
| April 11 | do | 3.7 | 123 | October 20 | do | | 54 |
| April 14 | do | 3.66 | 104 | October 24 | do | | 51 |
| April 18 | do | 3.58 | 93 | October 27 | do | | 50 |
| April 24 | do | 3.5 | 60 | October 31 | do | 4.20 | 49 |
| April 25 | R. S. Hawley | 3.5 | 38 | November 3 | do | 4.20 | 46 |
| April 29 | P. H. Leahy | 3.45 | 58 | November 7 | do | 4.29 | 81 |
| May 3 | do | 3.76 | 151 | November 10 | do | 4.21 | 66 |
| May 6 | do | 3.98 | 218 | November 14 | do | 4.20 | 62 |
| May 10 | do | 4.60 | 327 | November 17 | do | 4.16 | 58 |
| May 13 | do | | 260 | November 22 | do | 4.15 | 65 |
| May 16 | do | | 152 | November 24 | do | 4.16 | 73 |
| May 20 | do | 3.98 | 80 | November 28 | do | 4.15 | 67 |
| May 23 | do | | 65 | December 1 | do | 4.16 | 65 |
| May 27 | do | | 55 | December 5 | do | 4.09 | 72 |
| May 29 | do | | 48 | December 8 | do | 4.09 | 67 |
| June 2 | do | | 63 | December 12 | do | 4.02 | 65 |
| June 6 | do | | 51 | December 15 | do | 4.02 | 73 |
| June 10 | do | | 46 | December 19 | do | 4.05 | 71 |
| June 13 | do | | 39 | December 22 | do | 4.05 | 67 |
| June 16 | do | | 43 | December 26 | do | 4.03 | 66 |
| June 20 | do | | 43 | December 30 | do | 4.03 | 58 |

*Daily gage height, in feet, of Mohave River at Victorville, Cal., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.0 | 3.9 | 3.45 | 4.0 | 4.05 | 4.0 | 4.0 | 4.1 | 4.2 | 4.15 |
| 2 | 3.95 | 3.9 | 3.5 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 4.2 | 4.15 |
| 3 | ........ | 3.85 | 3.65 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 4.2 | 4.15 |
| 4 | 3.95 | 3.9 | 3.85 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 4.2 | 4.15 |
| 5 | 3.85 | 3.8 | 3.95 | 4.0 | 4.0 | 4.0 | 4.0 | 4.1 | 4.2 | 4.15 |
| 6 | 3.85 | 3.75 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.1 |
| 7 | 3.8 | 3.75 | 4.85 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.3 | 4.1 |
| 8 | 3.8 | 3.4 | 4.85 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.3 | 4.1 |
| 9 | 3.8 | 3.4 | ........ | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.25 | 4.1 |
| 10 | 3.75 | 3.65 | 4.6 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.05 |
| 11 | 3.75 | 3.65 | 4.6 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.05 |
| 12 | 3.75 | 3.65 | 4.2 | 4.0 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.0 |
| 13 | 9.95 | 3.65 | 4.2 | 4.05 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.0 |
| 14 | 5.0 | 3.65 | 4.1 | 4.05 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.0 |
| 15 | 5.0 | 3.6 | 4.1 | 4.05 | 4.0 | 4.0 | 4.0 | 4.15 | 4.2 | 4.0 |
| 16 | 5.05 | 3.6 | 4.05 | 4.05 | 4.0 | 4.0 | 4.0 | 4.15 | 4.15 | 4.0 |
| 17 | 4.1 | 3.6 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.0 |
| 18 | 4.05 | 3.6 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 19 | 4.05 | 3.55 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 20 | 4.05 | 3.65 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 21 | 4.05 | 3.6 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 22 | 4.05 | 3.6 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 23 | 4.0 | 3.5 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 24 | 4.0 | 3.5 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 25 | 4.0 | 3.5 | 3.95 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.2 | 4.05 |
| 26 | 4.0 | 3.5 | 3.95 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.2 | 4.05 |
| 27 | 4.0 | 3.45 | 4.0 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 28 | 3.85 | 3.45 | 4.2 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 29 | 3.8 | 3.45 | 4.1 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 30 | 4.2 | 3.45 | 4.1 | 4.05 | 4.0 | 4.0 | 4.0 | 4.2 | 4.15 | 4.05 |
| 31 | 3.9 | ........ | 4.0 | ........ | 4.0 | 4.0 | 4.0 | 4.2 | ........ | 4.05 |

*Daily discharge, in feet, of Mohave River at Victorville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 56 | 60 | 100 | 263 | 60 | 61 | 35 | 30 | a 47 | 40 | 48 | a 65 |
| 2 | 56 | 325 | a 98 | 237 | 100 | a 63 | 36 | a 30 | 44 | 40 | 47 | 66 |
| 3 | a 56 | 605 | a 90 | 211 | a 151 | 60 | a 36 | 30 | 41 | a 40 | a 46 | 68 |
| 4 | 57 | 713 | 90 | 185 | 172 | 57 | 35 | 29 | 38 | 40 | 55 | 70 |
| 5 | 58 | a 822 | 91 | 159 | 195 | 54 | 34 | a 29 | a 35 | 44 | 64 | a 72 |
| 6 | a 58 | 576 | a 91 | a 133 | a 218 | a 51 | 33 | 29 | 35 | a 49 | 72 | 67 |
| 7 | 61 | 328 | 88 | 133 | 246 | 50 | a 32 | 29 | 35 | 47 | a 81 | 67 |
| 8 | 64 | a 82 | 84 | a 133 | 272 | 49 | 32 | 29 | a 35 | 45 | 76 | a 67 |
| 9 | 67 | 84 | 81 | 133 | 300 | 47 | 32 | 29 | 35 | 43 | 71 | 67 |
| 10 | a 70 | 87 | 77 | 128 | a 327 | a 46 | 31 | 29 | 36 | a 41 | a 66 | 66 |
| 11 | 70 | a 90 | a 74 | a 123 | 296 | 44 | a 31 | 29 | a 37 | 41 | 65 | 66 |
| 12 | 71 | 90 | 74 | 118 | 273 | 41 | 29 | 29 | 38 | 41 | 64 | a 65 |
| 13 | a 71 | 90 | a5,410 | 110 | a 260 | a 39 | 28 | 29 | 39 | a 44 | 63 | 67 |
| 14 | 68 | 90 | 2,295 | a 104 | 224 | 40 | a 27 | 31 | 40 | 44 | a 62 | 70 |
| 15 | 65 | a2,032 | a 820 | 103 | 188 | 41 | 29 | 31 | a 42 | 44 | 61 | a 73 |
| 16 | 62 | 1,387 | a2,250 | 98 | a 152 | a 43 | 31 | 33 | 42 | 44 | 59 | 73 |
| 17 | a 59 | 150 | 1,665 | 95 | 134 | 43 | 34 | 33 | 42 | a 44 | a 58 | 72 |
| 18 | 59 | a 97 | a 980 | a 93 | 116 | 43 | a 36 | 33 | 42 | 47 | 60 | 71 |
| 19 | 59 | 96 | 920 | 86 | 98 | 43 | 35 | 33 | a 43 | 50 | 61 | a 71 |
| 20 | a 59 | 95 | 860 | 79 | a 80 | a 43 | 33 | 33 | 43 | a 54 | 62 | 70 |
| 21 | 59 | a 95 | 800 | 75 | 75 | 41 | a 32 | 36 | 43 | 53 | 64 | 68 |
| 22 | 59 | 95 | a 740 | 70 | 70 | 39 | 32 | 36 | a 43 | 52 | a 65 | a 67 |
| 23 | 58 | 95 | 647 | 65 | a 65 | 37 | 32 | 36 | 42 | 51 | 69 | 67 |
| 24 | 57 | 95 | 553 | a 60 | 63 | 35 | 31 | 36 | 42 | a 51 | a 73 | 67 |
| 25 | a 56 | 95 | a 460 | a 38 | 60 | 33 | a 30 | a 36 | 42 | 51 | 71 | 67 |
| 26 | 55 | 95 | 450 | 43 | 58 | 31 | 32 | 33 | a 42 | 51 | 70 | a 66 |
| 27 | a 53 | 95 | a 340 | 48 | a 55 | a 30 | 33 | 31 | 42 | a 50 | 69 | 64 |
| 28 | 54 | 95 | 327 | 53 | 52 | 31 | a 34 | a 29 | 42 | 50 | a 67 | 62 |
| 29 | 54 | ....... | 315 | a 58 | a 48 | 33 | 32 | 31 | a 42 | 50 | 67 | 60 |
| 30 | 55 | ....... | 302 | 60 | 53 | a 35 | 32 | 33 | 42 | 49 | 66 | a 58 |
| 31 | a 56 | ....... | 290 | ....... | 57 | ....... | 32 | a 35 | ....... | a 49 | ....... | 58 |

a Taken from discharge measurements.

NOTE.—Daily discharge obtained by interpolation between discharge measurements.

*Estimated monthly discharge of Mohave River at Victorville, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 71 | 53 | 60.1 | 3,695 |
| February | 2,032 | 60 | 309 | 17,160 |
| March | 5,410 | 74 | 695 | 42,734 |
| April | 263 | 38 | 110 | 6,545 |
| May | 327 | 48 | 146 | 8,977 |
| June | 63 | 30 | 43.4 | 2,583 |
| July | 36 | 27 | 32.3 | 1,986 |
| August | 36 | 29 | 31.6 | 1,943 |
| September | 47 | 34 | 40.0 | 2,380 |
| October | 54 | 40 | 46.5 | 2,859 |
| November | 81 | 46 | 64.0 | 3,808 |
| December | 73 | 58 | 67.0 | 4,120 |
| The year | 5,410 | 27 | 137 | 98,790 |

# SOUTHERN PACIFIC OCEAN DRAINAGE.

## GENERAL FEATURES.

The Southern Pacific Ocean drainage includes those streams south of San Francisco Bay whose waters, in times of flood at least, reach the Pacific Ocean.

## SAN LUIS REY RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The San Luis Rey River rises on the western slope of the Coast Range in the northern portion of San Diego County, and, flowing in a westerly direction, discharges its waters into the Pacific Ocean near the town of Oceanside. It has numerous small tributaries, none of which have their sources at elevations above 5,000 feet. On the upper reaches of this stream the country is rolling, with several small valleys which are under cultivation, being used principally for the raising of grain and the pasturage of stock. At a point below what is known as Warner's ranch reservoir site the river flows through a deep, narrow canyon, with a heavy grade for a distance of about 10 miles, below which point the grade is light and the discharge is over a sandy and gravelly bed, where the water soon disappears, again rising in small quantities near the town of Pala, where the gaging station is located. Below this point it flows for a distance of about 25 miles on a light grade to the Pacific Ocean. There is a good soil covering throughout this basin, with a considerable growth of brush and grass, and with small areas of timber on the extreme higher elevations. The water is diverted at several points along this stream for irrigation, a considerable quantity being diverted from the canyon above the gaging station and used in the vicinity of Escondido, which lies in an entirely separate drainage basin. This stream is torrential in its character, the discharge being very light except during the winter season, in times of heavy rainfall. The mean precipitation varies from 10 to 20 inches and falls principally in the form of rain, there being only a light fall of snow on the extreme higher elevations, which soon melts and only adds to the flood discharge.

### SAN LUIS REY RIVER NEAR PALA, CAL.

This station was established October 9, 1903, by W. B. Clapp. It is located at Sickler's mill, 4 miles above Pala, Cal. It is reached by driving from Fallbrook or Temecula, stations on the Southern California Railway, 18 and 13 miles distant, respectively.

The channel is straight for about 800 feet above and 2,000 feet below the station. The grade of the stream is 0.60 foot in 100 feet. The current is swift. The right bank rises abruptly about 15 feet beyond the oak tree to which the cable is fastened and is not liable to overflow. The left bank is low, but is not liable to overflow. It was once a portion of the river channel, but is now well above high-water marks. The bed of the stream is rocky in portions of the flood channel, but the low-water channel is clear of rocks. There is a considerable growth of small timber in the channel, but this has been cleared the entire width of the cross section for a distance of 100 feet above and 50 feet below the station. This timber growth is not permanent, being washed out by floods every few years.

Discharge measurements are usually made by wading. During high water they are made from a car suspended from a cable stretched across the river at the gage. The initial point for soundings is the base of the oak tree to which the left end of the cable is fastened.

The gage is an inclined staff fastened to tree stumps and stakes at the left bank of the river. During 1905 the gage was read once each day by M. M. Sickler. The bench mark is a United States standard bronze-capped iron post set flush with the ground on the right bank of the river and the north side of the wagon road, and about 50 feet west from the line of the cable prolonged. Its elevation is 557 feet above mean sea level and 26.98 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of San Luis Rey River near Pala, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 8 | E. C. La Rue | 44 | 43 | 2.51 | 2.25 | 108 |
| February 17 | F. M. Sickler | 51 | 70 | 2.69 | 2.72 | 188 |
| February 18 | do | 100 | 204 | 3.60 | 4.75 | 735 |
| March 17 | do | 188 | 679 | 7.14 | 7.50 | 5,180 |
| March 22 | R. S. Hawley | 67 | 100 | 3.05 | 2.64 | 305 |
| March 22 | F. M. Sickler | 68 | 96 | 3.11 | 2.64 | 299 |
| April 11 | do | 44 | 42 | 2.48 | 1.80 | 104 |
| May 15 | do | 41 | 26 | 1.88 | 1.20 | 49 |
| May 17 | do | 40 | 21 | 1.90 | 1.10 | 40 |
| May 20 | do | 43 | 25 | 2.28 | 1.40 | 57 |
| July 6 | do | 3.0 | 1.7 | 2.06 | .55 | 3.5 |
| August 8 | R. S. Hawley | 3.6 | 1.7 | 1.74 | ([a]) | 3 |
| August 19 | M. M. Sickler | 3.5 | 1.6 | 2.00 | | 3.2 |
| August 26 | do | 3.5 | 1.6 | 2.06 | | 3.3 |
| September 2 | do | 3.5 | 1.5 | 1.80 | | 2.7 |
| September 9 | do | 3.5 | 1.5 | 1.80 | | 2.7 |
| September 16 | do | 3.5 | 1.4 | 1.78 | | 2.5 |
| September 21 | D. W. Murphy | | | | | 2.1 |
| September 23 | F. M. Sickler | 3.5 | 1.4 | 2.00 | .42 | 2.8 |
| October 28 | do | 3.5 | 1.6 | 2.25 | .53 | 3.6 |
| December 27 | do | 7 | 4.1 | 3.15 | .63 | 12.9 |
| December 29 | do | 10.9 | 6.7 | 1.40 | .61 | 9.4 |

[a] Channel so uncertain from July 11 to September 23 that no readings were made.

*Estimated monthly discharge of San Luis Rey River near Pala, Cal., for 1903–1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1903. | | | | |
| October (23 days) | 1.5 | 1.0 | 1.1 | 50 |
| November | 1.5 | 1.0 | 1.4 | 83 |
| December | 1.5 | 1.0 | 1.2 | 74 |
| The period | | | | 207 |
| 1904. | | | | |
| January | 1.5 | 1.5 | 1.5 | 92 |
| February | 2.5 | 1.5 | 2.0 | 115 |
| March | 348 | 1.5 | 41.6 | 2,558 |
| April | 104 | 20 | 43.6 | 2,595 |
| May | 35 | 12 | 16.2 | 996 |
| June | 12 | 9 | 10.8 | 643 |
| July | 9 | 3 | 3.8 | 234 |
| August | 2 | 2 | 2.0 | 123 |
| September | 2 | 2 | 2.0 | 119 |
| October | 13 | 2 | 2.5 | 154 |
| November | 3 | 2 | 2.4 | 143 |
| December | 5.5 | 2 | 3.7 | 227 |
| The year | 348 | 1.5 | 11.0 | 7,999 |
| 1905. | | | | |
| January | 66 | 3 | 19.1 | 1,174 |
| February | 711 | 13 | 151 | 8,386 |
| March | 4,265 | 2 | 336 | 20,660 |
| April | 139 | 27 | 64.9 | 3,862 |
| May | 282 | 27 | 88.1 | 5,417 |
| June | 35 | 11 | 23 | 1,369 |
| July | 9 | 3 | 4.1 | 252 |
| August | 3.5 | 3 | 3 | 184 |
| September | 3.0 | 2.5 | 2.6 | 155 |
| October | 3.8 | 2.8 | 3.2 | 197 |
| November | 96.0 | 3.8 | 17.8 | 1,059 |
| December | 47.0 | 10 | 18.3 | 1,125 |
| The year | 4,265 | 2.0 | 60.9 | 43,840 |

NOTE.—The estimated monthly discharge is approximate only.

## SANTA ANA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Santa Ana River has its source in the southern slope of the San Bernardino Mountains and, flowing in a southwesterly direction, traverses San Bernardino Valley, below which it breaks in a narrow canyon through the Santa Ana Mountains, finally discharging its waters through Santa Ana Valley into the Pacific Ocean below the town of Santa Ana. This stream has numerous tributaries which rise in the southern slope of the San Bernardino Mountains, the surface flow of most of which only reach Santa Ana River, where it traverses San Bernardino Valley in times of flood discharge. The topography on the higher elevations is rough and rugged, reaching elevations of from 10,000 to 12,000 feet, the formation being of granite with good soil covering and considerable growth of timber. On the lower elevations the topography is less rough and the soil-covering is principally of brush. A gaging station is located on this stream at a point known as Warm Springs, a distance of about 8 miles above Redlands. Below this station the river leaves the mountainous country and discharges over a sandy and gravelly bed through San Bernardino Valley. During the summer months the entire flow of the stream is diverted above this gaging station and used for power development at the mouth of the canyon, below which point it is again taken out and used for irrigation on the higher elevations of San Bernardino Valley along the base of the mountains where the country is under a high state of cultivation, used principally for the raising of citrus fruits. The water rises to the surface in San Bernardino Valley near the city of San Bernardino and is diverted and used extensively for irrigation in the neighborhood of Riverside. In addition to this surface flow a large number of wells have been sunk in this territory, many of which are artesian, and from others the water is being pumped. This developed water is also used extensively for irrigation in the vicinity of San Bernardino and Riverside. The water is again forced to the surface by bed-rock obstructions at Riverside Narrows below the city of Riverside, and gradually increases in volume until it reaches Santa Ana Canyon, where it is diverted for irrigation on the lower valley lands in the vicinity of Santa Ana and Fullerton. During the summer months measurements are made of the flow at Rincon, Cal., at the head of Santa Ana Canyon. There are only occasional flood discharges of this river which flow continuously from the mountain to the sea. The mean precipitation throughout this basin is from 15 to 30 inches, which falls in the form of rain except on the higher elevations of the San Bernardino Mountains, where there is a considerable snowfall, which usually remains on the extreme high elevations until midsummer. A storage reservoir has been constructed on Bear Creek, a tributary of this stream, and is known as the Bear Valley reservoir. This stored water is held until the summer months and used for irrigation in San Bernardino Valley.

### SANTA ANA RIVER NEAR MENTONE, CAL.

This station was established in June, 1896. It is located 5 miles northeast of Mentone, Cal., three-fourths of a mile below the headworks of the Mentone Power Company's canal, and opposite the warm springs in the canyon.

The Edison Electric Company diverts the greater portion of the water from Santa Ana River above the gaging station, but also returns all of it above the station. They, however, allow only limited portions of the water to pass out of their conduits during certain hours of the day, holding back the water for the purpose of obtaining additional power when the greatest demand exists.

The Mentone Power Company's canal, formerly called the Santa Ana canal, diverts water above the station, all of which is returned below the point of measurement. During the low-water season the entire flow of the river is diverted by the canals.

The channel is straight for 100 feet above and below the station, and has a width of 22 feet at low and 125 feet at high stages. The current is swift at all stages. The right bank is low and is liable to overflow at flood stages for about 100 feet. The left bank is low but is not liable to overflow. Both banks are overgrown with alders. The bed of the stream is composed of firm sand and small bowlders. It is subject to considerable change during flood stages.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the bench-mark spike set in the north side of a cottonwood tree on the left bank, 30 feet west of the tree to which the cable is fastened. At flood stages the velocity is so high that measurements can be made only by means of floats.

The gage is an inclined timber fastened to a large bowlder on the left bank 100 feet above the cable. The channel was deepened by a flood March 31, 1903, and the gage was accordingly lowered to reach low-water stages June 30, 1903. During 1905 the gage was read once each day by A. Laird. The bench mark is a spike in the north side of the cottonwood tree on the left bank, 30 feet west of the tree to which the cable is fastened; elevation, 7.29 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Santa Ana River near Mentone, Cal., in 1905.*

| Date. | Hydrographer. | Gage height of river. | Discharge. | | |
|---|---|---|---|---|---|
| | | | River. | Mentone Power Company's canal. | Total for River. |
| | | *Feet.* | *Sec.-ft.* | *Sec.-ft.* | *Sec.-ft.* |
| February 13 | Clapp and La Rue | 1.15 | 10 | 40 | 50 |
| February 21 | E. C. La Rue | 1.70 | 17 | 74 | 91 |
| February 22 | do | 1.65 | 10 | 71 | 81 |
| February 23 | do | 1.65 | 11 | 63 | 74 |
| March 14 a.m | do | 2.60 | 188 | 0 | 188 |
| March 14 p.m | do | 2.50 | 138 | 50 | 188 |
| March 15 a.m | do | 2.30 | 132 | 57 | 189 |
| March 15 p.m | do | 2.10 | 113 | 57 | 170 |
| March 30 | R. S. Hawley | 1.90 | 81 | 46 | 127 |
| April 14, 1 p.m | do | 1.95 | 86 | 1 | 87 |
| May 17 | do | 2.25 | 111 | 37 | 148 |
| June 7 | do | 2.20 | 79 | 0 | 79 |
| June 26 | do | 1.43 | 4 | 66 | 70 |
| July 6 | do | 1.40 | 3 | 61 | 64 |

*Daily gage height, in feet, of Santa Ana River near Mentone, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.85 | 0.8 | 1.3 | 1.7 | 1.3 | 2.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.5 |
| 2 | .85 | 2.5 | 1.3 | 2.05 | 2.2 | 2.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.5 |
| 3 | .85 | 2.3 | 1.3 | 2.05 | 2.0 | 2.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 4 | .85 | 2.8 | 1.3 | 1.35 | 2.0 | 2.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 5 | .85 | 3.0 | 1.3 | 1.35 | 1.9 | 2.3 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 6 | .85 | 1.9 | 1.25 | 1.35 | 1.9 | 2.25 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 7 | .85 | 1.9 | 1.25 | 1.35 | 2.0 | 2.25 | 1.4 | 1.3 | 1.3 | 1.3 | 1.35 | 1.4 |
| 8 | .85 | 1.75 | 1.25 | 1.35 | 2.3 | 2.2 | 1.4 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 |
| 9 | 2.0 | 1.5 | 1.25 | 1.35 | 2.2 | 2.2 | 1.4 | 1.3 | 1.3 | 1.3 | 1.35 | 1.4 |
| 10 | 1.0 | 1.5 | 1.25 | 1.35 | 2.2 | 2.2 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 11 | .85 | 1.35 | 1.25 | 1.35 | 2.2 | 2.15 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 12 | .85 | 1.25 | 1.3 | 1.35 | 2.2 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 13 | .85 | 1.15 | 3.4 | 1.3 | 2.2 | 1.75 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 14 | .85 | 1.1 | 2.6 | 1.3 | 2.5 | 1.6 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 15 | .85 | 1.1 | 2.35 | 1.3 | 2.5 | 1.45 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 16 | .8 | 2.8 | 2.4 | 1.3 | 2.6 | 1.45 | 1.35 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 17 | .8 | 2.1 | 2.5 | 2.2 | 2.6 | 1.6 | 1.35 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 18 | .8 | 1.9 | 2.6 | 2.0 | 2.5 | 1.6 | 1.35 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 |
| 19 | .8 | 1.9 | 2.5 | 2.1 | 2.6 | 1.55 | 1.35 | 1.3 | 1.3 | 1.3 | 1.35 | 1.6 |
| 20 | .8 | 1.8 | 2.6 | 1.2 | 2.6 | 1.55 | 1.35 | 1.3 | 1.3 | 1.3 | 1.35 | 2.2 |
| 21 | 1.65 | 1.7 | 2.5 | 1.15 | 2.5 | 1.45 | 1.35 | 1.3 | 1.3 | 1.3 | 1.4 | 1.6 |
| 22 | .85 | 1.7 | 2.4 | 1.2 | 2.2 | 1.45 | 1.35 | 1.3 | 1.3 | 1.3 | 1.35 | 1.5 |
| 23 | .85 | 1.5 | 2.0 | 1.4 | 2.2 | 1.45 | 1.35 | 1.3 | 1.3 | 1.3 | 1.35 | 1.5 |
| 24 | .85 | 1.3 | 1.9 | 1.4 | 2.1 | 1.45 | 1.3 | 1.3 | 1.3 | 1.3 | 1.35 | 1.5 |
| 25 | .85 | 1.85 | 1.9 | 1.3 | 2.3 | 1.45 | 1.3 | 1.3 | 1.3 | 1.3 | 1.35 | 1.5 |
| 26 | .85 | 1.25 | 1.9 | 1.3 | 2.2 | 1.45 | 1.3 | 1.3 | 1.3 | 1.3 | 1.8 | 1.5 |
| 27 | .85 | 1.35 | 1.8 | 1.3 | 2.2 | 1.45 | 1.3 | 1.3 | 1.3 | 1.3 | 2.5 | 1.5 |
| 28 | .85 | 1.3 | 1.65 | 1.25 | 2.4 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 2.9 | 1.5 |
| 29 | .8 | ....... | 1.5 | 1.2 | 2.4 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.7 | 2.0 |
| 30 | .8 | ....... | 2.0 | 1.2 | 2.4 | 1.4 | 1.3 | 1.3 | 1.3 | 1.3 | 1.5 | 1.6 |
| 31 | .8 | ....... | 1.8 | ....... | 2.4 | ....... | 1.3 | 1.3 | ....... | 1.3 | ....... | 1.5 |

*Station rating table for Santa Ana River near Mentone, Cal., from January 1 to February 17, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 1 | 1.40 | 23 | 2.00 | 80 | 2.60 | 170 |
| 0.90 | 2 | 1.50 | 29 | 2.10 | 93 | 2.70 | 186 |
| 1.00 | 5 | 1.60 | 37 | 2.20 | 106 | 2.80 | 202 |
| 1.10 | 8 | 1.70 | 47 | 2.30 | 122 | 2.90 | 218 |
| 1.20 | 12 | 1.80 | 57 | 2.40 | 138 | 3.00 | 234 |
| 1.30 | 17 | 1.90 | 68 | 2.50 | 154 | | |

*Station rating table for Santa Ana River near Mentone, Cal., from February 18 to March 12 and from June 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 1 | 2.00 | 48 | 2.70 | 164 | 3.40 | 290 |
| 1.40 | 3 | 2.10 | 62 | 2.80 | 182 | 3.50 | 308 |
| 1.50 | 6 | 2.20 | 78 | 2.90 | 200 | 3.60 | 326 |
| 1.60 | 11 | 2.30 | 94 | 3.00 | 218 | 3.70 | 344 |
| 1.70 | 17 | 2.40 | 110 | 3.10 | 236 | 3.80 | 362 |
| 1.80 | 25 | 2.50 | 128 | 3.20 | 254 | 3.90 | 380 |
| 1.90 | 35 | 2.60 | 146 | 3.30 | 272 | | |

*Station rating table for Santa Ana River near Mentone, Cal., from March 13 to May 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 1 | 1.60 | 46 | 2.40 | 151 | 3.20 | 287 |
| 0.90 | 2 | 1.70 | 56 | 2.50 | 168 | 3.30 | 304 |
| 1.00 | 4 | 1.80 | 68 | 2.60 | 185 | 3.40 | 321 |
| 1.10 | 8 | 1.90 | 80 | 2.70 | 202 | 3.50 | 338 |
| 1.20 | 13 | 2.00 | 92 | 2.80 | 219 | 3.60 | 355 |
| 1.30 | 20 | 2.10 | 106 | 2.90 | 236 | 3.70 | 362 |
| 1.40 | 28 | 2.20 | 120 | 3.00 | 253 | 3.80 | 379 |
| 1.50 | 36 | 2.30 | 135 | 3.10 | 270 | | |

*Daily discharge, in second-feet, of Santa Ana canal near Mentone, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | 25 | 60 | 57 | 71 | 0 | 63 | 53 | 66 | 51 | 46 | 34 |
| 2 | 22 | 64 | 57 | 0 | 66 | 0 | 61 | 53 | 63 | 51 | 32 | 32 |
| 3 | 21 | 64 | 60 | 0 | 66 | 0 | 61 | 51 | 63 | 56 | 32 | 34 |
| 4 | 21 | 0 | 60 | 54 | 56 | 0 | 61 | 61 | 63 | 56 | 32 | 32 |
| 5 | 21 | 0 | 60 | 63 | 58 | 0 | 61 | 61 | 66 | 51 | 32 | 32 |
| 6 | 22 | 22 | 57 | 63 | 73 | 0 | 61 | 61 | 66 | 46 | 36 | 32 |
| 7 | 21 | 42 | 57 | 63 | 51 | 0 | 58 | 63 | 66 | 46 | 41 | 32 |
| 8 | 20 | 37 | 54 | 72 | 56 | 0 | 58 | 63 | 61 | 41 | 46 | 32 |
| 9 | 0 | 37 | 51 | 78 | 66 | 0 | 56 | 63 | 61 | 56 | 41 | 32 |
| 10 | 61 | 35 | 48 | 78 | 76 | 0 | 56 | 63 | 63 | 46 | 29 | 30 |
| 11 | 54 | 43 | 48 | 72 | 76 | 0 | 58 | 63 | 73 | 46 | 29 | 32 |
| 12 | 41 | 26 | 51 | 66 | 76 | 66 | 61 | 63 | 76 | 61 | 30 | 32 |
| 13 | 41 | 28 | 0 | 66 | 76 | 43 | 63 | 66 | 76 | 66 | 32 | 29 |
| 14 | 31 | 29 | 0 | 63 | 0 | 71 | 66 | 68 | 78 | 56 | 30 | 29 |
| 15 | 31 | 35 | 0 | 57 | 0 | 71 | 66 | 68 | 78 | 61 | 30 | 32 |
| 16 | 27 | 29 | 97 | 43 | 71 | 71 | 63 | 71 | 78 | 56 | 29 | 30 |
| 17 | 29 | 32 | 78 | 0 | 71 | 68 | 63 | 71 | 78 | 51 | 29 | 30 |
| 18 | 33 | 42 | 0 | 0 | 71 | 68 | 63 | 81 | 78 | 46 | 29 | 29 |
| 19 | 25 | 70 | 0 | 0 | 36 | 68 | 61 | 81 | 73 | 43 | 29 | 29 |
| 20 | 27 | 70 | 0 | 71 | 36 | 68 | 61 | 56 | 68 | 41 | 29 | 29 |
| 21 | 66 | 70 | 0 | 66 | 32 | 68 | 61 | 56 | 68 | 41 | 34 | 32 |
| 22 | 61 | 74 | 78 | 66 | 29 | 68 | 61 | 56 | 61 | 46 | 32 | 25 |
| 23 | 49 | 74 | 66 | 66 | 29 | 68 | 61 | 56 | 68 | 41 | 30 | 25 |
| 24 | 40 | 66 | 78 | 66 | 29 | 68 | 61 | 73 | 68 | 41 | 29 | 25 |
| 25 | 31 | 66 | 78 | 71 | 0 | 68 | 61 | 73 | 51 | 46 | 30 | 25 |
| 26 | 29 | 58 | 60 | 71 | 0 | 68 | 61 | 73 | 56 | 46 | 30 | 25 |
| 27 | 27 | 51 | 85 | 66 | 0 | 68 | 61 | 76 | 56 | 41 | 41 | 29 |
| 28 | 25 | 58 | 85 | 66 | 0 | 63 | 61 | 76 | 66 | 41 | 50 | 28 |
| 29 | 25 | ...... | 78 | 71 | 0 | 63 | 61 | 76 | 66 | 41 | 41 | 30 |
| 30 | 25 | ...... | 42 | 76 | 0 | 63 | 56 | 73 | 66 | 41 | 32 | 29 |
| 31 | 25 | ...... | 57 | ...... | 0 | ...... | 56 | 73 | ...... | 41 | ...... | 27 |

*Estimated monthly discharge of Santa Ana[a] River near Mentone, Cal., for 1905.*

[Drainage area, 182 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 108 | 22 | 36.6 | 2,251 | 0.201 | 0.232 |
| February | 234 | 26 | 97.6 | 5,420 | .536 | .558 |
| March | 321 | 48 | 130 | 7,993 | .714 | .823 |
| April | 120 | 63 | 90.5 | 5,385 | .497 | .554 |
| May | 256 | 91 | 172 | 10,580 | .945 | 1.09 |
| June | 94 | 64 | 77.7 | 4,624 | .427 | .476 |
| July | 69 | 57 | 62.9 | 3,867 | .346 | .399 |
| August | 82 | 52 | 66.8 | 4,107 | .367 | .423 |
| September | 79 | 52 | 68.3 | 4,064 | .375 | .418 |
| October | 67 | 42 | 49.2 | 3,025 | .270 | .311 |
| November | 250 | 30 | 47.5 | 2,827 | .261 | .291 |
| December | 107 | 31 | 38.4 | 2,362 | .211 | .243 |
| The year | 321 | 22 | 78.1 | 56,500 | .429 | 5.82 |

[a] Including Mentone Power Company's canal.

### SEEPAGE MEASUREMENTS.

In the vicinity of Colton and San Bernardino large quantities of water are developed in addition to the natural surface flow. This water is used for the irrigation of land in the vicinity of San Bernardino, Colton, and Riverside, and also for domestic supply for these towns. Much of this water returns to Santa Ana River below Riverside, above a point known as Slover Mountain and is again diverted and used for irrigation on the lower lands below Riverside, and above what is known as Riverside Narrows. Below this point there are still further diversions which irrigate the lower lands along the river bottom, much of this water again returning to the river above Rincon. Measurements were made during the summer of 1905 to determine the amount of water, including the natural flow and developed water, above Colton, Cal. Also measurements were made of natural flow and developed water below Slover Mountain and above Riverside Narrows, this all being return water from irrigated lands on the higher elevations. Measurements were also made of diversion ditches and Santa Ana River below Riverside Narrows and above what is known as the Auburndale Bridge. The following tabulations show the result of these measurements which were made by K. Sanborn, of Riverside, Cal.

*Natural flow of return water to Santa Ana River in second-feet, compared with developed water in San Bernardino Valley above Colton, Cal., 1905.*

[Measurements by K. Sanborn, engineer Riverside Water Company.]

| Date. | Location. | Developed. | Natural. | Total. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sec.-ft.* | *Sec.-ft.* |
| June 9 | Barnhill pumping plant | 1.10 | | 1.10 |
| September 27 | do | .80 | | .80 |
| June 10 | Beam ditch | | 0.00 | .00 |
| September 2 | do | | .00 | .00 |
| June 16 | Bloomington pumping plants | 6.62 | | 6.62 |
| September 27 | do | 7.20 | | 7.20 |
| June 10 | City of San Bernardino, Sixth street pumping plant. | 1.99 | | 1.99 |
| September 27 | do | 4.80 | | 4.80 |
| June 19 | Cty of San Bernardino, Lytle Creek | | 2.04 | 2.04 |
| September 27 | do | | 1.90 | 1.90 |
| June 9 | City of Colton pumping plant (total) | 3.81 | | 3.81 |
| September 27 | City of Colton (water used for irrigation) | 1.20 | | 1.20 |
| September 27 | City of Colton pumping plant (total) | 2.70 | | 2.70 |
| May 31 | Camp Carlton ditch | 2.60 | | 2.60 |
| August 14 | do | 1.20 | | 1.20 |
| June 10 | Carr pumping plant | .72 | | .72 |
| August 14 | do | .60 | | .60 |
| June 10 | Daley ditch | | .00 | .00 |
| September 4 | do | | .00 | .00 |
| May 30 | Excelsior Land and Water Co | .65 | | .65 |
| September 28 | do | .40 | | .40 |
| May 31 | Grand Terrace Pumping Co. pumping plant | .54 | | .54 |
| August 14 | do | .00 | | .00 |
| May 31 | Gage canal, Palm avenue weir | 28.83 | | 28.83 |
| September 2 | do | 32.70 | | 32.70 |
| May 26 | Gage canal intake, Santa Ana River | | .00 | .00 |
| September 4 | do | | .00 | .00 |
| June 2 | Haws & Talmadge ditch | | .00 | .00 |
| September 5 | do | | .00 | .00 |
| June 6 | Hunter pumping plant | 1.09 | | 1.09 |
| September 4 | do | 1.60 | | 1.60 |
| June 9 | Johnson & Hubbard pumping plant | .59 | | .59 |

*Natural flow of return water to Santa Ana River in second-feet, compared with developed water in San Bernardino Valley above Colton, Cal., 1905*—Continued.

| Date. | Location. | Developed. | Natural. | Total. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sec.-ft.* | *Sec.-ft.* |
| September 4 | Johnson & Hubbard pumying plant | 0.30 | | 0.30 |
| June 9 | Lamb pumping plant | .30 | | .30 |
| September 27 | do | .00 | | .00 |
| June 9 | Lawson Well Co. pumping plant | .62 | | .62 |
| September 27 | do | .60 | | .60 |
| June 10 | Logsdon & Farrell ditch | | 0.00 | .00 |
| September 2 | do | | .00 | .00 |
| June 10 | Lytle Creek Water and Improvement Co | .00 | | .00 |
| September 27 | do | .00 | | .00 |
| May 30 | Merryfield pumping plant | .67 | | .67 |
| September 28 | do | .40 | | .40 |
| June 2 | McKenzie ditch | | .00 | .00 |
| September 5 | do | | .00 | .00 |
| June 9 | Meeks & Daley ditch | | 15.70 | 15.70 |
| September 2 | do | | 15.50 | 15.50 |
| June 16 | McIntyre ditch | | .00 | .00 |
| September 28 | do | | .00 | .00 |
| June 9 | Orange Land and Water Co. pumping plant | .00 | | .00 |
| September 27 | do | 1.60 | | 1.60 |
| June 16 | Riverside Highland Water Co., Lytle Creek | 7.05 | | 7.05 |
| September 28 | do | 8.00 | | 8.00 |
| May 31 | Riverside Highland Water Co., Santa Ana River | 6.36 | | 6.36 |
| September 4 | do | 7.60 | .40 | 8.00 |
| June 16 | Rancheria pumping plant | 1.24 | | 1.24 |
| September 27 | do | 1.10 | | 1.10 |
| June 2 | Rabel ditch | | .00 | .00 |
| September 5 | do | | .00 | .00 |
| May 31 | Riverside Water Co., upper canal | 25.33 | 24.85 | 50.18 |
| August 31 | do | 21.20 | 12.90 | 34.10 |
| May 31 | Riverside Water Co., mill pumping plant | .92 | | .92 |
| August 31 | do | 1.30 | | 1.30 |
| May 31 | Riverside Water Co., mill flume | | 2.24 | 2.24 |
| August 31 | do | | .00 | .00 |
| May 26 | Riverside Water Co., flume pump No. 1 | 3.95 | | 3.95 |
| August 31 | do | 3.60 | | 3.60 |
| May 26 | Riverside Water Co., flume pump No. 2 | 3.18 | | 3.18 |
| August 31 | do | 3.00 | | 3.00 |
| June 6 | Rosedale Water Co. pumping plant | .30 | | .30 |
| September 28 | do | .00 | | .00 |
| June 6 | Rogers pumping plant | | .00 | .00 |
| August 31 | do | .00 | | .00 |
| June 2 | Shay or Stout Dam ditch | | .00 | .00 |
| September 5 | do | | .00 | .00 |
| May 31 | Swamp ditch | | .47 | .47 |
| August 14 | do | | .40 | .40 |
| June 6 | West Riverside 350-inch Water Co. pumping plant | 2.00 | | 2.00 |
| September 28 | do | 5.60 | | 5.60 |
| June 19 | Whitlock ditch | | .00 | .00 |
| September 2 | do | | .00 | .00 |
| June 6 | Whiting ditch | | .00 | .00 |
| September 4 | do | | .00 | .00 |
| May 31 | Ward and Warren ditch | .00 | | .00 |
| September 4 | do | | .00 | .00 |

*Return waters in San Bernardino Valley below Slover Mountain and above Riverside Narrows, 1905.*

[Measurements by K. Sanborn, engineer Riverside Water Company.]

| Date. | Location. | Developed. | Natural. | Total. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sec.-ft.* | *Sec.-ft.* |
| May 27 | Alvitrez ditch at headgate, east end of West Riverside Bridge. | | 3.00 | 3.00 |
| August 11 | do | | 1.30 | 1.30 |
| June 6 | Cuttle's pumping plant | 2.50 | | 2.50 |
| October 4 | do | 2.25 | | 2.25 |
| May 27 | Evans Island or Jansen ditch, under west end of West Riverside Bridge. | | .00 | .00 |
| August 11 | do | | .00 | .00 |
| May 29 | Evans ditch, near Riverside County line | | .00 | .00 |
| August 11 | do | | .50 | .50 |
| May 29 | Evans Well ditch, Santa Ana street | .00 | | .00 |
| August 9 | do | 1.70 | | 1.70 |
| May 30 | Evans pipe line to China garden at headworks | | .00 | .00 |
| August 11 | do | | .00 | .00 |
| May 27 | Evans pumping plant, 1,000 feet south of west end of West Riverside Bridge. | 2.87 | | 2.87 |
| September 5 | do | 4.20 | | 4.20 |
| June 19 | Evans Jurupa pumping plant at wier end of main | 2.00 | | 2.00 |
| October 4 | Evans Jurupa pumping plant | .00 | | .00 |
| May 30 | Ferris Gallagher ditch, near headworks | | 2.20 | 2.20 |
| August 14 | do | | 2.00 | 2.00 |
| May 30 | Gallagher ditch, near headworks | | .00 | .00 |
| August 14 | do | | 1.20 | 1.20 |
| May 29 | Jurupa pumping plant, to supply Rubidoux ditch | 2.10 | | 2.10 |
| August 15 | do | 4.80 | | 4.80 |
| May 30 | Lower Canal Riverside Water Co. at flume at headworks. | | 2.20 | 2.20 |
| September 5 | do | | .00 | .00 |
| June 6 | Pond's pumping plant | 2.50 | | 2.50 |
| October 4 | do | 2.25 | | 2.25 |
| May 29 | Rubidoux ditch at measuring box | | 4.92 | 4.92 |
| August 15 | do | | 7.20 | 7.20 |
| June 15 | Riverside Power Co. canal at Pedley crossing | | 30.60 | 30.60 |
| September 22 | do | | 27.00 | 27.00 |
| June 19 | Rivero Land Co. pumping plant | .80 | | .80 |
| October 4 | do | .60 | | .60 |
| May 29 | Smith or Evans ditch, 1 mile below Riverside County line. | | 2.30 | 2.30 |
| August 14 | do | | .00 | .00 |
| May 27 | Soquel ditch at intake | | 3.20 | 3.20 |
| August 11 | do | | 2.70 | 2.70 |
| May 27 | Spring Brook pumping plant at wier end of main | | 5.58 | 5.58 |
| August 11 | do | | 3.60 | 3.60 |
| May 29 | Spanishtown pumping plant at wier end of main | 4.17 | | 4.17 |
| August 11 | do | 2.60 | | 2.60 |
| May 30 | Zimmerman pipe line at dam | | 1.40 | 1.40 |
| August 14 | do | | 1.20 | 1.20 |

*Discharge measurements of canals between the Riverside Narrows and the Auburndale bridge having their source in the Santa Ana River, 1905.*

| Date. | Location. | Discharge. |
|---|---|---|
| | | *Sec.-ft.* |
| June 15 | Castele ditch near intake | 0.00 |
| September 22 | do | .00 |
| June 15 | Durkee ditch at Auburndale road crossing | 4.10 |
| September 22 | do | .00 |
| June 15 | Fuller ditch at waste gate | 5.60 |
| September 22 | do | 5.40 |
| June 15 | Gilliland ditch at Auburndale road crossing | 1.40 |
| September 22 | do | .30 |
| June 15 | Newton ditch near intake | 2.30 |
| September 22 | do | 1.70 |
| June 15 | Newberry ditch at Auburndale road crossing | .00 |
| September 22 | do | .00 |
| June 15 | Roberts or Le Gay ditch near intake Santa Ana River | 1.00 |
| September 22 | do | 1.70 |
| June 15 | Wilbur ditch at Rogers pipe trestle crossing Santa Ana River | 6.10 |
| September 22 | do | 6.40 |
| June 15 | Santa Ana River, Auburndale Bridge | 63.60 |
| Do | Santa Ana River, Auburndale Bridge, including ditches | 71.13 |
| September 22 | Santa Ana River, Auburndale Bridge | 57.00 |
| Do | Santa Ana River, Auburndale Bridge, including ditches | 57.80 |

## MISCELLANEOUS MEASUREMENTS IN SANTA ANA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Santa Ana River drainage basin during 1905:

*City Creek near Highlands, Cal.*—This stream is a tributary of Santa Ana River. A measurement was made September 23 by W. B. Clapp in diversion canal at mouth of canyon Measurement made over weir.

Discharge, 1.16 second-feet.

*Chino Creek near Rincon, Cal.*—This stream is a tributary of Santa Ana River. The following measurements were made during 1905 at the wagon bridge at Rincon road crossing, one-fourth mile above junction of Chino Creek with the Santa Ana river.

February 24: Width, 16 feet; area, 22 square feet; mean velocity, 2.09 feet per second; discharge, 46 second-feet.

April 17: Width, 7 feet; area, 5.6 square feet; mean velocity, 4.64 feet per second; discharge, 26 second-feet.

May 16: Width, 5 feet; area, 4 square feet; mean velocity, 4.25 feet per second; discharge, 17 second-feet.

June 6: Width, 4 feet; area, 1.7 square feet; mean velocity, 3.53 feet per second; discharge, 6.0 second-feet.

July 29: Width, 2 feet; area, 0.4 square foot; mean velocity, 2.75 feet per second; discharge, 1.1 second-feet.

September 21: Width, 3 feet; area, 2 square feet; mean velocity, 0.95 foot per second; discharge, 1.9 second-feet.

*Cable Canyon Creek near Glen Helen, Cal.*—This stream is a tributary of the Santa Ana River. A measurement was made July 13 by K. Sanborn. Measurement made over weir.

Discharge, 1.66 second-feet.

*Devil Canyon near Irvington Station, Cal.*—This stream is a tributary of the Santa Ana River. A measurement was made July 13 by K. Sanborn at the mouth of the canyon, 100 feet below head of M. L. & W. Co.'s ditch.

Discharge, 1.26 second-feet.

*East Twin Creek near Arrowhead Springs, Cal.*—This stream is a tributary of the Santa Ana River. A measurement was made September 23 by W. B. Clapp at the mouth of the canyon. Measurement made over weir.

Discharge, 0.54 second-foot.

*Lytle Creek near Rialto, Cal.*—This stream is one of the principal tributaries of the Santa Ana River. A measurement was made June 16 by K. Sanborn at the head of Fontella Development Company's canal at the mouth of the canyon. Measurement made over weir.

Discharge, 23 second-feet.

*Mill Creek near Mentone, Cal.*—This stream is one of the principal tributaries of the Santa Ana River. The following measurements were made during 1905:

At road crossing between Mentone and Santa Ana Canyon, April 14: Width, 16 feet; area, 11.2 square feet; mean velocity, 4.11 feet per second; discharge, 46 second-feet. This is waste water and does not include water diverted by Crafton Zanja.

At head of Crafton Zanja, September 23: Width, 7.7 feet; area, 4.7 square feet; mean velocity, 4.33 feet per second; discharge, 20 second-feet.

*Morton Canyon Creek near Mentone, Cal.*—This stream is a small tributary of Santa Ana River. A measurement was made September 22 by W. B. Clapp at the mouth of the canyon, 500 feet above its junction with Santa Ana River.

Width, 0.8 foot; area, 0.096 square foot; mean velocity, 1.67 feet per second; discharge, 0.16 second-foot.

*Plunge Creek near East Highlands, Cal.*—This stream is a tributary of the Santa Ana River. The following measurements were made during 1905:

At road crossing Orange avenue between Redlands and Highlands, April 15: Width, 16 feet; area, 5.1 square feet; mean velocity, 1.94 feet per second; discharge, 9.9 second-feet.

At cement ditch at the mouth of the canyon, September 22: Width, 2 feet; area, 0.6 square foot; mean velocity, 1.67 foot per second; discharge, 1.0 second-foot.

*Redlands tunnel near Mentone, Cal.*—This is developed water from tunnel in the bed of the Santa Ana River at the mouth of the canyon. A measurement was made September 22 over weir at the mouth of the tunnel.

Discharge, 1.1 second-feet.

*Santa Ana River near Redlands, Cal.*—A measurement of this stream was made at the road crossing at Orange avenue between Redlands and Highlands April 14.

Width, 55 feet; area, 34 square feet; mean velocity, 2.35 feet per second; discharge, 76 second-feet.

*Santa Ana River near Rincon, Cal.*—The following measurements were made during 1905 at the Rincon wagon bridge, at the lower end of San Bernardino Valley, and the head of the lower Santa Ana Canyon. These measurements, with the addition of those of Chino Creek, show the total discharge of the Santa Ana River below all diversions in San Bernardino Valley, and show the amount of water which is used for irrigation in the vicinity of Orange, Santa Ana, Anaheim, and Fullerton, Cal., diversions being made below this point of measurement.

The gage is a 1 by 4 inch timber, graduated to feet and tenths and bolted to the first caisson from the south end of the Rincon wagon bridge. There is no bench mark.

February 24: Width, 40 feet; area, 68 square feet; mean velocity, 3.01 feet per second; gage height, 3.63 feet; discharge, 205 second-feet.

April 17: Width, 48 feet; area, 68 square feet; mean velocity, 2.53 feet per second; gage height, 3.60 feet; discharge, 172 second-feet.

May 16: Width, 45 feet; area, 50 square feet; mean velocity, 2.30 feet per second; gage height, 3.35 feet; discharge, 115 second-feet.

June 6: Width, 45 feet; area, 44 square feet; mean velocity, 1.98 feet per second; gage height, 3.32 feet; discharge, 87 second-feet.

July 29: Width, 48 feet; area, 34 square feet; mean velocity, 2.06 feet per second; gage height, 3.25 feet; discharge, 70 second-feet.

September 21: Width, 46 feet; area, 39 square feet; mean velocity, 1.95 feet per second; gage height, 3.33 feet; discharge, 76 second-feet.

*Waterman Canyon Creek or West Twin Creek, near Arrowhead Springs, Cal.*—This stream is a tributary of Santa Ana River. A measurement was made July 13 by K. Sanborn at the bridge on the road to Waterman's ranch at the mouth of the canyon.

Discharge, 1.02 second-feet.

## SAN GABRIEL RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The San Gabriel River rises in the Sierra Madre Mountains and, flowing in a southwesterly direction through the San Gabriel and Los Angeles valleys, discharges its waters into the Pacific Ocean near Long Beach, Cal. In the upper reaches of this basin there are numerous tributaries, which have their source in the higher elevations of the Sierra Madre Range. The topography in the upper reaches of this basin is rough and rugged, with deep and narrow canyons, while on the lower elevations the country is rolling, with large areas of valley land. The formation on the higher mountain elevation is of granite, with a light soil covering, with sparse timber growth. As one approaches the middle elevations the covering is brush, with scattering timber, while in the foothill country there is nothing but a growth of grass. The gaging station on this stream is located at a point where the stream leaves the higher mountains in the vicinity of Azusa. Below this point the river enters San Gabriel Valley, where the stream has a comparatively light grade, the bed being composed of bowlders, gravel, and sand, in which the water quickly disappears, except in times of flood discharge. The waters of this stream again appear on the surface at the lower end of San Gabriel Valley, at the discharge from the foothills, where an obstruction to the underground passage forces the water to the surface, on which it flows for a short distance and again disappears in the sands of the flat country below the foothills. The entire flow of this stream during the summer months is diverted at a point about 5 miles above the gaging station and is used for power purposes at the mouth of the canyon. From this point it is carried in ditches and used for irrigation in San Gabriel Valley. The water is again diverted where it appears on the surface at the lower end of this valley and is used for irrigation on the lower levels below this point. The mean precipitation in this basin varies from 15 to 30 inches and is principally in the form of rain. On small areas in the higher mountain elevations the precipitation is in the form of snow, which melts in the early spring months.

### SAN GABRIEL RIVER AND CANALS NEAR AZUSA, CAL.

Owing to the numerous diversions, it has been difficult to obtain accurate discharge measurements at Azusa, but during 1898 the San Gabriel Electric Company completed its system, and measurements are now obtained with greater ease and hence with greater accuracy. The headworks of this company are located about 6 miles above the mouth of the canyon. The water is carried around the left side by a series of tunnels and conduits, and a head of 400 feet is obtained where the electric power is generated. Weirs are placed on the conduit of the electric company and the water is measured at this point. The capacity of the conduit is 80 second-feet.

The cable and gage are located about 1 mile from Azusa. During the season of low water for a period of from six to eight months the canals above the station divert the entire flow and there is no running water at the station. The total flow of the river is obtained by adding the daily discharge for the river to the figures for the corresponding dates for the canals.

The channel is straight for 100 feet above and 500 feet below the cable and has a width of 280 feet at high water. At low stages there are two channels having different elevations, and accurate measurements are difficult to obtain. The bed of the stream is composed of cobblestones and bowlders, and the current is swift.

Discharge measurements are made by means of a cable and car. The gage is a vertical staff. During 1905 the gage was read by Don. D. Morgan.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of San Gabriel River and canals near Azusa, Cal., in 1905.*

| Date. | Hydrographer. | Gage height. | Discharge. | | |
|---|---|---|---|---|---|
| | | | River. | Canal. | Total. |
| | | *Feet.* | *Sec.-feet.* | *Sec.-feet.* | *Sec.-feet.* |
| February 10 | E. C. La Rue | 2.20 | 190 | 66 | 256 |
| February 17 | do | 3.50 | 560 | 66 | 626 |
| March 12 | R. S. Hawley | 9.30 | 11,055 | 72 | 11,127 |
| March 14 | W. B. Clapp | 5.30 | 2,030 | 70 | 2,100 |
| March 16 | R. S. Hawley | 5.80 | 3,225 | 80 | 3,305 |
| March 24 | do | 4.20 | 611 | 54 | 665 |
| March 31 | do | 3.80 | 400 | 80 | 480 |
| April 13 | do | 3.45 | 262 | 80 | 342 |
| April 19 | do | 3.30 | 190 | 80 | 270 |
| May 2 | do | 4.12 | 553 | 80 | 633 |
| May 9 | do | 3.50 | 288 | 80 | 368 |
| June 5 | do | 2.91 | 97 | 80 | 177 |
| June 23 | W. B. Clapp | 2.60 | 41 | 84 | 125 |
| July 5 | Hawley and Clapp | 2.28 | 17 | 85 | 102 |
| November 4 | W. B. Clapp | | 00 | 30 | 30 |

*Daily gage height, in feet, of San Gabriel River near Azusa, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 2.1 | [a]3.8 | 3.1 | 2.95 | 2.4 |
| 2 | 0 | 2.6 | 2.1 | [a]3.75 | 3.7 | 2.95 | 2.35 |
| 3 | 0 | 5.5 | 2.1 | [a]3.75 | 3.4 | 2.95 | 2.35 |
| 4 | 0 | [a]4.75 | 2.1 | [a]3.7 | 3.3 | 2.9 | 2.35 |
| 5 | 0 | 4.0 | 2.3 | [a]3.7 | 3.2 | 2.9 | 2.25 |
| 6 | 0 | 3.0 | 2.3 | [a]3.65 | 3.2 | 2.9 | 2.25 |
| 7 | 0 | 2.7 | 1.7 | [a]3.65 | 3.2 | 2.85 | 2.2 |
| 8 | 0 | 2.5 | 1.7 | [a]3.6 | 4.0 | 2.85 | 2.15 |
| 9 | 0 | 2.3 | 1.65 | [a]3.6 | 3.6 | 2.85 | 2.15 |
| 10 | 0 | 2.2 | 1.65 | [a]3.55 | 3.5 | 2.8 | 2.15 |
| 11 | 0 | 2.0 | 1.7 | [a]3.55 | 3.4 | 2.8 | 2.55 |
| 12 | 0 | 1.9 | 9.3 | [a]3.5 | 3.4 | 2.8 | 2.15 |
| 13 | 0 | 1.8 | [a]7.3 | 3.5 | 3.3 | 2.8 | 2.15 |
| 14 | 0 | 1.8 | 5.3 | 3.45 | 3.3 | 2.8 | 2.1 |
| 15 | 0 | [a]3.0 | 4.7 | [a]3.4 | 3.3 | 2.75 | 2.1 |
| 16 | 0 | [a]3.5 | 5.8 | [a]3.4 | 3.3 | 2.7 | 2.05 |
| 17 | 0 | [a]3.5 | 5.1 | [a]3.4 | 3.3 | 2.7 | 2.0 |
| 18 | 0 | 3.1 | 4.8 | [a]3.35 | 3.3 | 2.7 | 1.9 |
| 19 | 0 | 3.0 | 4.7 | 3.3 | 3.3 | 2.65 | 1.8 |
| 20 | 0 | 2.8 | 4.4 | 3.3 | 3.2 | 2.6 | 1.5 |
| 21 | 0 | 2.7 | 4.3 | 3.3 | 3.2 | 2.6 | ([b]) |
| 22 | 1.55 | 2.5 | 4.2 | 3.3 | 3.2 | 2.6 | ........ |
| 23 | 0 | 2.4 | 4.2 | 3.2 | 3.2 | 2.6 | ........ |
| 24 | 0 | 2.3 | 4.2 | 3.2 | 3.15 | 2.6 | ........ |
| 25 | 0 | 2.2 | 4.2 | 3.2 | 3.1 | 2.55 | ........ |
| 26 | 0 | 2.2 | [a]4.2 | 3.2 | 3.1 | 2.55 | ........ |
| 27 | 0 | 2.2 | [a]4.1 | 3.1 | 3.1 | 2.55 | ........ |
| 28 | 0 | 2.2 | [a]4.0 | 3.1 | 3.1 | 2.5 | ........ |
| 29 | 0 | ........ | 4.0 | 3.1 | 3.1 | 2.45 | ........ |
| 30 | 0 | ........ | [a]3.9 | 3.05 | 3.05 | 2.45 | ........ |
| 31 | 0 | ........ | 3.8 | ........ | 3.0 | ........ | ........ |

[a] Estimated.

[b] Dry from July 21 to December 31.

**Note.**—Gage washed out on March 12; replaced April 19. Gage heights taken with a level between March 12 and April 19.

*Station rating table for San Gabriel River near Azusa, Cal., from February 2 to March 11, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 0 | 2.50 | 207 | 3.60 | 610 | 4.70 | 1,620 |
| 1.50 | 55 | 2.60 | 231 | 3.70 | 670 | 4.80 | 1,750 |
| 1.60 | 65 | 2.70 | 259 | 3.80 | 730 | 4.90 | 1,900 |
| 1.70 | 76 | 2.80 | 289 | 3.90 | 800 | 5.00 | 2,050 |
| 1.80 | 88 | 2.90 | 320 | 4.00 | 870 | 5.10 | 2,220 |
| 1.90 | 101 | 3.00 | 351 | 4.10 | 950 | 5.20 | 2,390 |
| 2.00 | 115 | 3.10 | 390 | 4.20 | 1,040 | 5.30 | 2,570 |
| 2.10 | 130 | 3.20 | 430 | 4.30 | 1,140 | 5.40 | 2,750 |
| 2.20 | 147 | 3.30 | 470 | 4.40 | 1,250 | 5.50 | 2,940 |
| 2.30 | 165 | 3.40 | 513 | 4.50 | 1,370 | | |
| 2.40 | 185 | 3.50 | 560 | 4.60 | 1,490 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during first part of 1905; 1904 table applies from January 1 to February 1, inclusive.

*Station rating table for San Gabriel River near Azusa, Cal., from March 12 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 1 | 3.20 | 170 | 4.70 | 1,040 | 6.40 | 4,499 |
| 1.80 | 2.5 | 3.30 | 202 | 4.80 | 1,160 | 6.60 | 4,951 |
| 1.90 | 4.5 | 3.40 | 237 | 4.90 | 1,300 | 6.80 | 5,403 |
| 2.00 | 7 | 3.50 | 273 | 5.00 | 1,460 | 7.00 | 5,855 |
| 2.10 | 10 | 3.60 | 311 | 5.10 | 1,640 | 7.20 | 6,307 |
| 2.20 | 14 | 3.70 | 351 | 5.20 | 1,830 | 7.40 | 6,759 |
| 2.30 | 18 | 3.80 | 394 | 5.30 | 2,030 | 7.60 | 7,211 |
| 2.40 | 24 | 3.90 | 441 | 5.40 | 2,245 | 7.80 | 7,663 |
| 2.50 | 32 | 4.00 | 492 | 5.50 | 2,470 | 8.00 | 8,115 |
| 2.60 | 42 | 4.10 | 550 | 5.60 | 2,695 | 8.20 | 8,567 |
| 2.70 | 55 | 4.20 | 616 | 5.70 | 2,920 | 8.40 | 9,019 |
| 2.80 | 71 | 4.30 | 687 | 5.80 | 3,145 | 8.60 | 9,471 |
| 2.90 | 90 | 4.40 | 762 | 5.90 | 3,370 | 8.80 | 9,923 |
| 3.00 | 113 | 4.50 | 841 | 6.00 | 3,595 | 9.00 | 10,375 |
| 3.10 | 140 | 4.60 | 935 | 6.20 | 4,047 | 9.20 | 10,828 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905.

*Daily discharge, in second-feet, of San Gabriel canals near Azusa, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 | 34 | 67 | 80 | 80 | 80 | 85 | 55 | 34 | 30 | 29 | 50 |
| 2 | 23 | 67 | 67 | 80 | 80 | 80 | 85 | 54 | 33 | 29 | 29 | 47 |
| 3 | 21 | 70 | 67 | 80 | 80 | 80 | 86 | 54 | 32 | 28 | 29 | 45 |
| 4 | 20 | 78 | 67 | 80 | 80 | 80 | 85 | 53 | 33 | 28 | 29 | 44 |
| 5 | 19.5 | 68 | 0 | 80 | 80 | 80 | 85 | 52 | 34 | 28 | 29 | 44 |
| 6 | 19 | 78 | 67 | 80 | 80 | 80 | 86 | 50 | 35 | 28 | 32 | 42 |
| 7 | 18.5 | 69 | 72 | 80 | 80 | 80 | 86 | 47 | 34 | 28 | 44 | 42 |
| 8 | 18.5 | 86 | 72 | 80 | 48 | 80 | 85 | 46 | 33 | 28 | 95 | 41 |
| 9 | 41 | 74 | 72 | 80 | 80 | 80 | 85 | 45 | 32 | 27 | 53 | 39 |
| 10 | 59 | 66 | 72 | 80 | 80 | 80 | 85 | 45 | 32 | 27 | 42 | 37 |
| 11 | 40 | 66 | 72 | 80 | 80 | 73 | 71 | 46 | 32 | 27 | 38 | 37 |
| 12 | 35 | 66 | 72 | 80 | 80 | 73 | 74 | 44 | 32 | 27 | 36 | 37 |
| 13 | 31 | 66 | 0 | 80 | 80 | 76 | 75 | 44 | 32 | 28 | 36 | 38 |
| 14 | 29 | 66 | 70 | 80 | 80 | 76 | 74 | 43 | 31 | 29 | 34 | 39 |
| 15 | 27 | 66 | 79 | 80 | 80 | 0 | 74 | 43 | 31 | 29 | 34 | 39 |
| 16 | 30 | 67 | 80 | 80 | 80 | 78 | 74 | 42 | 30 | 29 | 45 | 39 |
| 17 | 30 | 66 | 80 | 80 | 80 | 78 | 74 | 41 | 31 | 30 | 53 | 39 |
| 18 | 28 | 68 | 80 | 80 | 80 | 78 | 74 | 40 | 31 | 30 | 43 | 39 |
| 19 | 28 | 69 | 79 | 80 | 80 | 78 | 73 | 41 | 30 | 30 | 40 | 38 |
| 20 | 27 | 68 | 80 | 80 | 80 | 78 | 73 | 41 | 29 | 29 | 42 | 46 |
| 21 | 55 | 68 | 80 | 80 | 80 | 78 | 70 | 40 | 29 | 29 | 41 | 42 |
| 22 | 67 | 68 | 78 | 80 | 80 | 88 | 69 | 40 | 28 | 31 | 39 | 39 |
| 23 | 67 | 68 | 57 | 80 | 80 | 84 | 68 | 39 | 30 | 32 | 38 | 38 |
| 24 | 57 | 67 | 54 | 80 | 80 | 84 | 67 | 38 | 30 | 31 | 37 | 37 |
| 25 | 46 | 68 | 69 | 80 | 80 | 84 | 64 | 38 | 30 | 30 | 37 | 38 |
| 26 | 41 | 67 | 80 | 80 | 80 | 84 | 62 | 36 | 29 | 29 | 37 | 38 |
| 27 | 40 | 67 | 80 | 80 | 80 | 84 | 64 | 36 | 30 | 29 | 97 | 38 |
| 28 | 38 | 67 | 80 | 80 | 80 | 84 | 62 | 35 | 31 | 28 | 87 | 38 |
| 29 | 37 | ....... | 80 | 80 | 80 | 84 | 60 | 34 | 32 | 28 | 62 | 37 |
| 30 | 36 | ....... | 80 | 80 | 80 | 84 | 68 | 33 | 31 | 29 | 53 | 37 |
| 31 | 34 | ....... | 80 | ....... | 80 | ....... | 56 | 33 | ....... | 28 | ....... | 38 |

*Estimated monthly discharge of San Gabriel River[a] near Azusa, Cal., for 1905.*

[Drainage area, 222 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 108 | 18.5 | 36.6 | 2,251 | 0.165 | 0.190 |
| February | 3,010 | 34 | 466 | 25,880 | 2.10 | 2.19 |
| March | 11,130 | 142 | 1,222 | 75,140 | 5.50 | 6.34 |
| April | 474 | 206 | 329 | 19,580 | 1.48 | 1.65 |
| May | 540 | 193 | 278 | 17,090 | 1.25 | 1.44 |
| June | 182 | 63 | 139 | 8,271 | .626 | .698 |
| July | 109 | 56 | 83.0 | 5,103 | .374 | .431 |
| August | 55 | 33 | 42.8 | 2,631 | .193 | .222 |
| September | 35 | 28 | 31.4 | 1,869 | .141 | .157 |
| October | 32 | 27 | 28.8 | 1,771 | .130 | .150 |
| November | 97 | 29 | 44.7 | 2,660 | .201 | .224 |
| December | 50 | 37 | 40.1 | 2,466 | .181 | .209 |
| The year | 11,130 | 18.5 | 2,284 | 164,700 | 1.03 | 13.90 |

[a] Includes water in canal.

## MISCELLANEOUS MEASUREMENTS IN SAN GABRIEL RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the San Gabriel River drainage basin during 1905:

*Baldwin ditch near El Monte, Cal.*—This ditch diverts water from the Rio Hondo River and is used for irrigation of land in the vicinity of the Old Mission. A measurement was made October 6 by W. B. Clapp at Old Mission Bridge, 4 miles below El Monte, Cal.

Width, 1.2 feet; area, 1.4 square feet; mean velocity, 2.14 feet per second; discharge, 3.0 second-feet.

*Cate ditch near El Monte, Cal.*—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Rivera, Cal. A measurement was made October 6 by W. B. Clapp in flume at road crossing near county road between El Monte and Whittier and about 5 miles below El Monte.

Width, 4 feet; area, 7.7 square feet; mean velocity, 1.45 feet per second; discharge, 11.2 second-feet.

*Ranchito or Standerford ditch near El Monte, Cal.*—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Rivera and Downey, Cal. A measurement was made October 6 by W. B. Clapp 25 feet below head-gate and about 5 miles below El Monte, Cal.

Width, 11.8 feet; area, 11 square feet; mean velocity, 1.42 feet per second; discharge, 15.6 second-feet.

*Los Nietos or Banta ditch.*—This ditch diverts water from the San Gabriel River and is used for the irrigation of land in the vicinity of Los Nietos, Cal. A measurement was made October 6 by W. B. Clapp 100 feet below head-gate of Ranchito ditch.

Width, 18 feet; area, 14.8 square feet; mean velocity, 1.14 feet per second; discharge, 16.8 second-feet.

*Rio Hondo near El Monte, Cal.*—This stream constitutes one branch of the San Gabriel River. A measurement was made October 6 by W. B. Clapp at Old Mission Bridge, 4 miles below El Monte and below the diversion of the Baldwin ditch.

Width, 13 feet; area, 12 square feet; mean velocity, 1.75 feet per second; discharge, 21 second-feet.

*Rincon ditch near El Monte, Cal.*—This ditch diverts water from the San Gabriel River 2 miles below Southern Pacific Railroad bridge and is used for irrigation of land in the vicinity of Rincon, Cal. A measurement was made October 6 by W. B. Clapp at road crossing, one-half mile east of the Durfee ranch.

Width, 6 feet; area, 3.2 square feet; mean velocity, 1.06 feet per second; discharge, 3.4 second-feet.

*Sheep Creek ditch near El Monte, Cal.*—This ditch diverts water from Sheep Creek, a tributary of San Gabriel River. A measurement was made October 6 by W. B. Clapp in flume at road crossing, 1 mile east of Durfee ranch.

Width, 3 feet; area, 2.1 square feet; mean velocity, 2.19 feet per second; discharge, 4.6 second-feet.

*Santa Anita Creek near Sierra Madre, Cal.*—This stream is a tributary of the San Gabriel River. A measurement was made October 23 by W. B. Clapp at the mouth of the canyon above Baldwin diversion.

Width, 3 feet; area, 1.0 square foot; mean velocity, 1.50 feet per second; discharge, 1.5 second-feet.

*San Gabriel River near El Monte, Cal.*—A measurement was made of this stream on April 13 by R. S. Hawley at wagon bridge, 2 miles east of El Monte, Cal.

Width, 56 feet; area, 20 square feet; mean velocity, 2.35 feet per second; discharge, 47 second-feet.

## LOS ANGELES RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Los Angeles River is formed by the Tujunga, Pacoima, and other small creeks which have their source in the Sierra Madre Range of mountains to the northeast of the city of Los Angeles. These streams leave the mountains at a point about 25 miles above the city and enter the comparatively flat country of San Fernando Valley, where, except in times of excessive flood, the waters disappear in the sand and gravel washes of the valley. These waters again make their appearance at the lower end of this valley, where a secondary range of hills, extending from east to west, forces the waters to the surface in what is known as Los Angeles River. Below this point the river discharges through the flat country of Los Angeles Valley, finally entering the Pacific Ocean near the town of Long Beach, Cal. During the summer months the entire flow of Los Angeles River is diverted at a point about 5 miles above Los Angeles for the supply of the city, and only a small amount of water passes this point except during flood discharge of the river. The topography is rough in the upper reaches of this drainage basin, the streams discharging in deep, narrow canyons. In this portion of the drainage basin the formation is of granite, with good soil covering and light timber and heavy brush growth. There is a considerable area of foothill country within this basin, lying between the base of the Sierra Madre Range and Los Angeles Valley, which has a light covering of brush and grass. The soil of San Fernando Valley consists principally of river wash, coarse sand, and gravel, except along the base of the mountains and foothills, where the soil is of good depth and is under a high state of cultivation. The soil of Los Angeles Valley, below the city of Los Angeles, consists of a light sandy loam and is under a high state of cultivation. The mean precipitation throughout this basin is from 15 to 30 inches and falls in the form of rain, except on small areas on the higher mountain elevations.

### MISCELLANEOUS MEASUREMENTS IN LOS ANGELES RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Los Angeles River drainage basin during 1905:

*Arroyo Seco near Pasadena, Cal.*—This stream is a tributary of Los Angeles River. The following measurements were made on this stream during 1905 by W. B. Clapp:

At mouth of canyon, 5 miles above Pasadena, Cal., April 11: Width, 13.5 feet; area, 8.1 square feet; mean velocity, 2.11 feet per second; discharge, 17.1 second-feet.

At Devils Gate, 3 miles above Pasadena, Cal., April 11: Width, 8 feet; area, 8.7 square feet; mean velocity, 1.44 feet per second; discharge, 12.5 second-feet.

At point 1,000 feet above submerged dam of Pasadena Land and Water Company, at Pasadena, Cal., April 11: Width, 8 feet; area, 2 square feet; mean velocity, 1.30 feet per second; discharge, 2.6 second-feet.

At sycamore grove, near Morgan's south line, Los Angeles, Cal., by J. B. Lippincott, October 27: Width, 1.1 feet; area, 0.16 square foot; mean velocity, 0.64 foot per second; discharge, 0.10 second-foot.

At sycamore grove, 600 feet above Morgan's south line, October 27: Width, 1.2 feet; area, 0.20 square foot; mean velocity, 1.14 feet per second; discharge, 0.23 second-foot.

*Big Tejunga Creek near Sunland, Cal.*—This stream is a tributary of the Los Angeles River. The following measurements were made during 1905 by R. S. Hawley:

At mouth of canyon, 1 mile above Sunland, Cal., April 12: Width, 25 feet; area, 13.7 square feet; mean velocity, 4.45 feet per second; discharge, 61 second-feet.

At Southern Pacific Company's railroad crossing near Pacoima, Cal., April 12: Width, 25 feet; area, 10.3 square feet; mean velocity, 2.82 feet per second; discharge, 29 second-feet.

Two miles below Southern Pacific Railroad bridge at Pacoima, Cal., April 12: No discharge.

*Little Tejunga Creek near Sunland, Cal.*—This stream is a tributary of Los Angeles River and discharges into Big Tejunga Creek below Sunland. A measurement was made April 11 by R. S. Hawley at mouth of canyon two-thirds of a mile above the junction with Big Tejunga Creek.

Width, 6 feet; area, 1.6 square feet; mean velocity, 2.06 feet per second; discharge, 3.3 second-feet.

*Pacoima Creek near Fernando, Cal.*—This stream is a tributary of Los Angeles River. The following measurements were made during 1905 by R. S. Hawley:

At mouth of canyon, 5 miles above Fernando, Cal., April 12: Width, 20 feet; area, 7.3 square feet; mean velocity, 4.11 feet per second; discharge, 30 second-feet.

At Southern Pacific Railroad bridge, 1 mile east of Fernando, Cal., April 12: Width, 10 feet; area, 6.2 square feet; mean velocity, 2.84 feet per second; discharge, 17.6 second-feet.

Three miles below Southern Pacific Railroad bridge, near Fernando, Cal., April 12: No discharge.

## MISCELLANEOUS MEASUREMENTS ON LOS ANGELES RIVER.

The following measurements were made on Los Angeles River at Los Angeles, Cal., during 1905:

*At Fourth Street Bridge.*—March 13: Width, 120 feet; area, 446 square feet; mean velocity, 10.15 feet per second; discharge, 4,525 second-feet.

*At Huron street.*—April 12: Width, 38 feet; area, 20 square feet; mean velocity, 2.15 feet per second; discharge, 43 second-feet.

*At Ninth Street Bridge.*—April 12: Width, 13 feet; area, 5.8 square feet; mean velocity, 2.19 feet per second; discharge, 12.7 second-feet.

During the summer of 1905 measurements were made to determine the amount of water diverted by the city of Los Angeles for domestic supply and also to determine the amount of water which passes the city's diversion point. The amount of water diverted for the city's supply is shown in measurements made in the 44-inch conduit and the main supply conduit. The amount of water discharging in the river below these points of diversion is shown by measurements made at Huron street. The following measurements were made during 1905 at these points:

*Measurements on Los Angeles River in Los Angeles.*

| Date. | 44-inch conduit discharge. | Main supply conduit discharge. | Huron street. | | | |
|---|---|---|---|---|---|---|
| | | | Width. | Area. | Mean velocity. | Discharge. |
| | *Sec.-ft.* | *Sec.-ft.* | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Sec.-ft.* |
| May 15 | 42 | 11 | 24 | 7.2 | 1.47 | 10.6 |
| June 22 | 38 | 9.9 | 16 | 3.2 | 1.03 | 3.3 |
| July 28 | 37 | 8.4 | 6 | 2.2 | 1.77 | 4.6 |
| September 19 | 35.3 | 8.7 | 6 | 2.2 | 1.55 | 3.4 |

## MALIBU CREEK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Malibu Creek rises in the Santa Monica Mountains and enters the Pacific Ocean about 15 miles above the town of Santa Monica. This stream is formed by Triunfo and Las Virgenes creeks, which drain the northern portion of the Santa Monica Range and the lower foothill country to the north. The formation throughout this basin is shale, sandstone, and conglomerate, with good soil covering. There is a sparse growth of timber on the higher elevations, but a greater portion of this area has a covering of brush and grass used extensively for pasturage, with limited areas of cultivated land for the raising of grain. A reservoir has been constructed on the upper reaches of the Triunfo Creek and the waters are used for irrigation within the basin during the summer months. This reservoir covers an area of about 300 acres when filled.

The mean precipitation in this basin amounts to about 25 inches and falls wholly in the form of rain.

### MALIBU CREEK NEAR CALABASAS, CAL.

This station was established November 29, 1901, by S. G. Bennett. It is located at Chapman's ranch, 40 miles from Los Angeles, by wagon road, and 8 miles southwest of Calabasas, about one-fourth mile below the mouth of Las Virgenes Creek.

The channel section is poor and subject to change during high water, but is at the only point where an observer could be secured. The excessive cost of visiting the station has made it impossible to obtain as many meter measurements as desired, but the observer is instructed to take float velocities at various gage heights, and these data, with cross sections and slope, are used in addition to meter measurements for computing discharges for use in constructing rating curves and tables. The estimated discharge is a rough approximation only.

The channel is straight for about 600 feet above the station and curved for about 300 feet below. The current is swift. Both banks are high. The right bank is rocky, and the bed of the stream is composed of rock and gravel.

The initial point for soundings is on the right bank. The gage rod is a vertical staff fastened to an alder tree on the right bank. During 1905 the gage was read by J. G. Chapman. The bench mark is a cross on a small projection on a rock bluff about 10 feet southwest of the gage rod; elevation, 5.43 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Malibu Creek near Calabasas, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 20 | R. S. Hawley | 9 | 6.2 | 1.5 | 0.9 | 9.3 |
| May 12 | do | 9 | 6.3 | 1.35 | .82 | 8.5 |

*Daily gage height, in feet, of Malibu Creek near Calabasas, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.2 | 1.2 | 1.1 | 1.5 | 0.8 | 0.6 | 0.5 | 0.5 | 0.5 | 0.4 | 0.45 | 0.5 |
| 2 | 1.2 | 1.3 | 1.1 | 1.25 | .8 | .6 | .5 | .5 | .5 | .4 | .45 | .5 |
| 3 | 1.2 | 1.6 | 1.1 | 1.2 | .8 | .6 | .5 | .5 | .5 | .4 | .45 | .5 |
| 4 | 1.2 | 2.85 | 1.1 | 1.2 | .8 | .6 | .5 | .5 | .5 | .4 | .45 | .5 |
| 5 | 1.2 | 1.85 | 1.1 | 1.2 | .8 | .6 | .5 | .5 | .5 | .4 | .55 | .5 |
| 6 | 1.2 | 2.1 | 1.1 | 1.25 | .8 | .6 | .5 | .5 | .5 | .4 | .55 | .5 |
| 7 | 1.2 | 1.3 | 1.1 | 1.25 | 1.3 | .6 | .5 | .5 | .5 | .4 | .55 | .5 |
| 8 | 1.2 | 1.2 | 1.1 | 1.25 | .9 | .6 | .5 | .5 | .5 | .4 | .55 | .5 |
| 9 | 1.2 | 1.15 | 1.1 | 1.2 | .9 | .6 | .6 | .5 | .5 | .4 | .55 | .5 |
| 10 | 1.2 | 1.15 | 1.1 | 1.2 | .9 | .6 | .6 | .5 | .5 | .4 | .55 | .6 |
| 11 | 1.2 | 1.15 | 1.0 | 1.2 | .9 | .6 | .6 | .5 | .45 | .4 | .55 | .6 |
| 12 | 1.2 | 1.15 | 7.6 | 1.1 | .9 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 13 | 1.2 | 1.15 | 4.2 | 1.25 | .9 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 14 | 1.2 | 1.1 | 3.25 | 1.0 | .7 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 15 | 1.2 | 1.1 | 3.25 | 1.0 | .7 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 16 | 1.2 | 1.8 | 4.75 | 1.0 | .7 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 17 | 1.2 | 1.65 | 3.55 | 1.0 | .7 | .6 | .6 | .5 | .45 | .4 | .6 | .6 |
| 18 | 1.2 | 1.55 | 2.8 | .9 | .7 | .6 | .6 | .5 | .4 | .4 | .6 | .6 |
| 19 | 1.22 | 1.4 | 2.5 | .9 | .7 | .6 | .6 | .5 | .4 | .4 | .6 | .6 |
| 20 | 1.25 | 1.3 | 2.4 | .9 | .7 | .6 | .6 | .5 | .4 | .4 | .6 | .6 |
| 21 | 1.3 | 1.2 | 2.4 | .9 | .7 | .6 | .6 | .5 | .4 | .4 | .6 | .6 |
| 22 | 1.24 | 1.2 | 2.3 | .9 | .7 | .6 | .6 | .5 | .4 | .4 | .6 | .6 |
| 23 | 1.2 | 1.15 | 2.2 | .9 | .7 | .6 | .5 | .5 | .45 | .4 | .6 | .6 |
| 24 | 1.2 | 1.1 | 2.2 | .9 | .7 | .6 | .5 | .5 | .45 | .4 | .6 | .6 |
| 25 | 1.2 | 1.1 | 1.0 | .9 | .7 | .5 | .5 | .5 | .45 | .4 | .6 | .6 |
| 26 | 1.2 | 1.1 | 1.6 | .9 | .7 | .5 | .5 | .5 | .45 | .4 | .5 | .6 |
| 27 | 1.2 | 1.1 | 1.45 | .9 | .7 | .5 | .5 | .5 | .45 | .4 | .5 | .6 |
| 28 | 1.2 | 1.1 | 1.55 | .8 | .6 | .5 | .5 | .5 | .45 | .4 | .5 | .6 |
| 29 | 1.2 | ....... | 1.7 | .8 | .6 | .5 | .5 | .5 | .45 | .45 | .5 | .6 |
| 30 | 1.2 | ....... | 1.7 | .8 | .6 | .5 | .5 | .5 | .45 | .45 | .5 | .6 |
| 31 | 1.2 | ....... | 1.55 | ....... | .6 | ....... | .5 | .5 | ....... | .45 | ....... | .6 |

*Estimated monthly discharge of Malibu Creek near Calabasas, Cal., for 1905.*

[Drainage area, 97 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 10 | 5 | 5.4 | 332 | 0.056 | 0.065 |
| February | 560 | 2 | 36.1 | 2,005 | .372 | .387 |
| March | 6,800 | 1 | 484. | 29,760 | 4.99 | 5.75 |
| April | 41 | 8 | 14.4 | 857 | .148 | .165 |
| May | 24 | 4 | 7.3 | 449 | .075 | .086 |
| June | 4 | 3 | 3.8 | 226 | .039 | .044 |
| July | 3 | 3 | 3.0 | 184 | .031 | .036 |
| August | 3 | 3 | 3.0 | 184 | .031 | .036 |
| September | 3 | 1 | 2.1 | 125 | .022 | .024 |
| October | 2 | 1 | 1.1 | 68 | .011 | .013 |
| November | 4 | 2 | 3.6 | 214 | .037 | .041 |
| December | 4 | 3 | 3.7 | 228 | .038 | .044 |
| The year | 6,800 | 1 | 47.3 | 34,630 | .488 | 6.69 |

NOTE.—The estimated monthly discharge is only an approximation.

### TRIUNFO CREEK NEAR CALABASAS, CAL.

This station is located 8 miles southwest of Calabasas, Cal., about one-half mile above the mouth of Las Virgenes Creek.

The channel section is poor and subject to change during high water, but is at the only point where an observer could be secured. The excessive cost of visiting the station has made it impossible to obtain as many meter measurements as desired, but the observer is instructed to take float velocities during floods at various gage heights, and these data, with cross sections and grade of stream, are used in addition to meter measurements for computing discharges for use in constructing rating curves and tables. The estimated discharge from this stream is a rough approximation only.

The channel is straight for about 400 feet above and 800 feet below the station, and the water is swift. Both banks are high and rocky. The bed of the stream is composed of gravel and sand and is shifting.

The initial point for soundings is on the right bank. The gage rod is a vertical staff bolted to rock cliff on right bank. During 1905 the gage was read by J. G. Chapman. The bench mark is a cross on a point of rock 3.5 feet above the bed of the creek on the right bank; elevation, 4.53 feet above the datum of the gage.

Information in regard to this section is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Triunfo Creek near Calabasas, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 20 | R. S. Hawley | 15 | 7.1 | 1.13 | 1.60 | 8.0 |
| May 12 | do | 17 | 6.3 | 1.13 | 1.44 | 7.1 |

*Daily gage height, in feet, of Triunfo Creek near Calabasas, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | | 0.00 | 0.5 | 1.3 | | 1.3 | 1.0 |
| 2 | | .75 | .5 | 1.5 | | 1.3 | 1.1 |
| 3 | | .9 | .5 | 1.5 | | 1.3 | 1.1 |
| 4 | | 2.15 | .5 | 1.5 | | 1.3 | 1.1 |
| 5 | | 1.65 | .5 | 1.5 | | 1.3 | 1.1 |
| 6 | | 2.2 | .5 | 1.5 | | 1.3 | 1.1 |
| 7 | | 1.65 | .5 | 1.6 | 1.4 | 1.3 | 1.1 |
| 8 | | 1.0 | .5 | 1.6 | .8 | 1.3 | 1.1 |
| 9 | | .9 | .5 | 1.6 | .4 | 1.3 | 1.2 |
| 10 | | .7 | .45 | 1.5 | | 1.3 | 1.2 |
| 11 | | .55 | .45 | 1.55 | | 1.25 | 1.2 |
| 12 | | .5 | 6.0 | 1.5 | | 1.25 | 1.2 |
| 13 | | .5 | 2.55 | 1.5 | | 1.25 | 1.2 |
| 14 | | .3 | 2.15 | 1.5 | 1.2 | 1.25 | 1.2 |
| 15 | | .3 | 2.05 | 1.5 | 1.2 | 1.25 | 1.2 |
| 16 | | 1.65 | 3.3 | 1.5 | 1.2 | 1.25 | 1.2 |
| 17 | | 1.45 | 3.1 | 1.5 | 1.2 | 1.25 | 1.2 |
| 18 | | 1.3 | 2.6 | 1.5 | 1.2 | 1.2 | 1.2 |
| 19 | | 1.2 | 2.25 | 1.4 | 1.2 | 1.2 | 1.2 |
| 20 | | 1.1 | 1.2 | 1.4 | 1.2 | 1.2 | 1.2 |
| 21 | | .9 | 1.2 | 1.4 | 1.2 | 1.2 | 1.2 |
| 22 | | .85 | 1.2 | 1.4 | 1.2 | 1.2 | 1.2 |
| 23 | | .8 | 1.1 | | 1.2 | 1.2 | 1.1 |
| 24 | | .8 | 2.2 | | 1.2 | 1.2 | 1.1 |
| 25 | | .7 | 1.6 | | 1.2 | 1.0 | 1.1 |
| 26 | | .7 | 1.4 | | 1.3 | 1.0 | 1.1 |
| 27 | | .7 | 1.4 | | 1.3 | 1.0 | 1.1 |
| 28 | | .6 | 1.3 | | 1.3 | 1.0 | 1.1 |
| 29 | | | 1.4 | | 1.3 | 1.0 | 1.1 |
| 30 | | | 1.4 | | 1.3 | 1.0 | 1.0 |
| 31 | | | 1.4 | | 1.3 | | 0.0 |

NOTE.—Creek dry Jan 2 to Feb. 1, Apr. 23 to May 6, May 10-13, Aug. 1 to Dec. 31.

*Estimated monthly discharge of Triunfo Creek near Calabasas, Cal., for 1905.*

[Drainage area, 72 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| February | 410 | 0 | 26.2 | 1,455 | .364 | .379 |
| March | 5,000 | 1 | 353.0 | 21,700 | 4.90 | 5.65 |
| April | 40 | 0 | 11.2 | 666 | .156 | .174 |
| May | 6 | 0 | 1.0 | 61 | .014 | .016 |
| June | 2 | 1 | 1.3 | 77 | .018 | .020 |
| July | 1 | 0 | .97 | 60 | .013 | .015 |
| August | 0 | 0 | .0 | 0 | .0 | .0 |
| September | 0 | 0 | .0 | 0 | .0 | .0 |
| October | 0 | 0 | .0 | 0 | .0 | .0 |
| November | 0 | 0 | .0 | 0 | .0 | .0 |
| December | 0 | 0 | .0 | 0 | .0 | .0 |
| The year | 5,000 | 0 | 32.8 | 24,020 | .455 | 6.25 |

NOTE.—The estimated monthly discharge is only an approximation.

## SANTA CLARA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Santa Clara River rises in the Coast Range in the northwestern part of Los Angeles County and flows in a westerly direction, discharging its waters into the Pacific Ocean near Ventura, Cal. It has numerous tributaries from the north, all of which are torrential in their character, having a heavy discharge during the winter months. This stream has a comparatively flat grade, flowing over a sandy and gravelly bed, into which it sinks during a greater portion of the year. At numerous points along its course the water rises to the surface during the summer and flows for a short distance, again disappearing in the sand. At points where the waters make their appearance on the surface numerous diversions are made for irrigation along the valley, where the soil is deep and is under the highest state of cultivation, this being especially the case on the lower reaches of the river below the town of Santa Paula. The principal tributaries of this stream are Piru Creek, Sespe Creek, and Santa Paula Creek, all of which produce a very heavy flood discharge of short duration during the rainy season, but during the summer months have a light discharge. On the upper reaches of the principal tributaries of this stream the topography is rough and broken, the streams discharging through deep canyons. This is especially noticeable on the Sespe Creek. On the upper reaches of the main stream the country is rolling and has a sparse covering of timber with a considerable growth of brush and grass, and is used extensively for pasturage. The formation is of shale, sandstone, and conglomerate throughout the entire basin. The precipitation is extremely light in the upper reaches of this basin, but increases on the lower reaches nearer the Pacific Ocean and falls in the form of rain.

### MISCELLANEOUS MEASUREMENTS IN SANTA CLARA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Santa Clara River drainage basin during 1905:

*Camulos ditch near Camulos, Cal.*—This ditch diverts water from the Santa Clara River 1 mile above Camulos, Cal. The water is used for the irrigation of land at Camulos. A measurement was made October 19 by W. B. Clapp in a flume about 1,000 feet below the head of the canal.

Width, 3.5 feet; area, 3.5 square feet; mean velocity, 2.17 feet per second; discharge, 7.6 second-feet.

*Farmers' canal near Santa Paula, Cal.*—This canal diverts water from the Santa Clara River at a point 1 mile above Santa Paula, Cal. The water is used for irrigation of land between Santa Paula and Saticoy, Cal. A measurement was made October 21 by W. B. Clapp in flume 200 feet below where canal crosses Santa Clara River, about 1 mile above the town of Santa Paula, Cal.

Width, 4 feet; area, 4.8 square feet; mean velocity, 1.50 feet per second; discharge, 7.2 second-feet.

*Grees ditch near Santa Paula, Cal.*—This ditch diverts water from the Santa Clara River about 1 mile above the town of Santa Paula, Cal. The water is used for the irrigation of land between Santa Paula and Saticoy. A measurement was made on October 21 by W. B. Clapp at a point 200 feet below head of ditch and about 1 mile above the town of Santa Paula, Cal.

Width, 8 feet; area, 6.6 square feet; mean velocity, 1.39 feet per second; discharge, 9.2 second-feet.

*Piru Land and Water Company's upper diversion near Esperanza, Cal.*—This water is diverted from Piru Creek for domestic and irrigation purposes in the town of Piru, Cal. A measurement was made October 20 by W. B. Clapp at point of diversion at head of pipe line, 1 mile above the town of Esperanza, Cal.

Width, 5 feet; area, 1.5 square feet; mean velocity, 0.93 foot per second; discharge, 1.4 second-feet.

*Piru Creek near Esperanza, Cal.*—This stream is a tributary of the Santa Clara River. A measurement was made October 20 by W. B. Clapp at point 1 mile above Esperanza, Cal., and below the upper diversion of the Piru Land and Water Company.

Width, 8 feet; area, 2.4 square feet; mean velocity, 1.42 feet per second; discharge, 3.4 second-feet. For total flow of Piru Creek at this point add upper diversion of Piru Land and Water Company.

*Piru Creek near Piru City, Cal.*—A measurement was made October 20 by W. B. Clapp 1 mile above Piru City and above lower diversion of Piru Land and Water Company.

Width, 8 feet; area, 2.8 square feet; mean velocity, 1.90 feet per second; discharge, 5.3 second-feet. This measurement shows total flow of Piru Creek at this point and includes the discharge of Piru Creek 1 mile above Esperanza, Cal. The increase is caused by seepage water along the creek.

*Sespe Land and Water Company's canal near Sespe, Cal.*—This canal diverts water from Sespe Creek and is used for irrigation of land in the vicinity of Sespe. A measurement was made October 20 by W. B. Clapp one-half mile below head of canal.

Width, 5.2 feet; area, 4.5 square feet; mean velocity, 1.47 feet per second; discharge, 6.6 second-feet.

*Sespe Creek near Sespe, Cal.*—This creek is a tributary of the Santa Clara River. A measurement was made October 20 by W. B. Clapp one-half mile below heading of Sespe Land and Water Company's canal.

Width, 4 feet; area, 2.9 square feet; mean velocity, 1.66 feet per second; discharge, 4.8 second-feet. For total flow of Sespe Creek add discharge of Sespe Land and Water Company's canal as shown by measurement made on this date.

*San Francisquito Creek near Saugus, Cal.*—This creek is a tributary of the Santa Clara River. A measurement was made October 19 by W. B. Clapp at road crossing near Newhall ranch, 3½ miles below Saugus, Cal., and 500 feet above junction with Santa Clara River

Width, 5 feet; area, 2.8 square feet; mean velocity, 0.46 foot per second; discharge, 1.3 second-feet.

*Santa Paula Creek near Santa Paula, Cal.*—This stream is a tributary of the Santa Clara River. A measurement was made October 21 by W. B. Clapp 3 miles above Santa Paula and above diversion of the Santa Paula Land and Water Company.

Width, 11 feet; area, 5.6 square feet; mean velocity, 0.88 foot per second; discharge, 4.9 second-feet. This measurement shows total discharge of Santa Paula Creek on this date.

*Santa Clara River near Saugus, Cal.*—A measurement was made October 19 by W. B. Clapp at road crossing near Newhall ranch, 3½ miles below Saugus, Cal.

Width, 6 feet; area, 3.8 square feet; mean velocity, 1.39 feet per second; discharge, 5.3 second-feet.

*Santa Clara River near Camulos, Cal.*—A measurement was made October 19 by W. B. Clapp at a point 1 mile above Camulos and 1,000 feet below diversion of Camulos ditch.

Width, 11 feet; area, 4.9 square feet; mean velocity, 2.06 feet per second; discharge, 10.1 second-feet. For total discharge of Santa Clara River at this point add discharge of Camulos ditch.

*Santa Clara River near Santa Paula, Cal.*—A measurement was made October 21 by W. B. Clapp 1 mile above Santa Paula and about 500 feet below diversion of Farmers and Grees canals.

Width, 33 feet; area, 17.4 square feet; mean velocity, 1.55 feet per second; discharge, 27 second-feet. For total diversion of Santa Clara River at this point add discharge of Farmers and Grees canals.

*Santa Clara River near Saticoy, Cal.*—A measurement was made October 21 by W. B. Clapp at a point opposite Saticoy and 200 feet below head of Santa Clara Water and Irrigation Company's canal.

Width, 14 feet; area, 14.7 square feet; mean velocity, 1.63 feet per second; discharge, 24 second-feet. For total discharge of Santa Clara River at this point add discharge of Santa Clara Water and Irrigation Company's canal.

*Santa Clara Water and Irrigation Company's canal near Saticoy, Cal.*—This canal diverts water from the Santa Clara River and is used for the irrigation of Santa Clara ranch near Oxnard, Cal.

Measurement made over weir. Discharge equals 16.7 second-feet.

## SANTA YNEZ RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Santa Ynez River rises in the mountains of Santa Barbara and Ventura counties and flows westerly with a flat grade to the Pacific Ocean, having a length of approximately 75 miles. The Santa Ynez Range of mountains, varying in elevation from 3,000 to 4,000 feet, forms the southern boundary of this drainage basin. The northern divide ranges from 4,500 to 5,500 feet in elevation, culminating in Mount Pinos, the elevation of which is 8,826 feet. The northern part of the watershed is drained by streams running in a southerly direction and uniting with the Santa Ynez River proper, which runs close to the northerly base of the Santa Ynez Mountains, flowing westerly and paralleling the Coast Range. The principal tributary, Mono Creek, enters from the north.

The formation throughout the entire drainage basin consists chiefly of shale and sandstone, the strike being parallel to the coast and the dip nearly vertical, inclining somewhat to the south.

The greater portion of the drainage is sparsely covered with brush and small trees, only a small area on the higher elevations having any considerable growth of timber.

The mean annual precipitation is estimated at 25 inches for the entire area and falls almost entirely in the form of rain.

There are several reservoir sites on Santa Ynez and its tributaries which have been surveyed.

### SANTA YNEZ RIVER NEAR SANTA BARBARA, CAL.

The original station, at which measurements were made during the greater part of 1903, was located about 1 mile above the mouth of Mono Creek. On November 1, 1903, the old station was abandoned and a new station established by L. M. Hyde. It is located at the Gibraltar dam site, 5 miles below the original station, and is below the mouth of Mono Creek. It is 9 miles above the San Marcus ranch and halfway between the old quicksilver mines.

The channel is straight for 700 feet above and 600 feet below the station. The right bank is low, but is not liable to overflow. The left bank rises abruptly about 20 feet beyond the tree to which the cable is attached. It is not liable to overflow. The bed of the stream is composed of sand and gravel, free from vegetation and bowlders. The cross section is regular and is permanent. The current is swift.

Discharge measurements are made at high water by means of a cable. Measurements can can usually be made by wading. The initial point for soundings is a blaze at the base of the cottonwood tree on the right bank, to which the cable is attached.

The gage is an inclined timber spiked to a cottonwood tree on the right bank. The tree is blazed and graduated above the gage rod for recording stages above the gage. The bench mark is a cross on a bench of a ledge of rock on the left bank, about 100 feet below the cable. Elevation, 13.54 feet above the datum of the gage. The approximate elevation above sea level, as estimated from topographic maps, is 1,200 feet.

Information in regard to this station is contained in Water Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Daily gage height, in feet, of Santa Ynez River near Santa Barbara, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 2.5 | 3.1 | 3.25 | 2.65 | 2.4 | 2.05 | 2.0 | 1.9 | 1.8 | 1.8 | 2.05 |
| 2 | 2.3 | 3.6 | 3.05 | 3.25 | 2.7 | 2.4 | 2.05 | 2.0 | 1.9 | 1.8 | 1.8 | 2.05 |
| 3 | 2.25 | 8.4 | 3.0 | 3.2 | 2.65 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.8 | 2.05 |
| 4 | 2.25 | 6.8 | 3.0 | 3.15 | 2.6 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.8 | 2.05 |
| 5 | 2.25 | 4.0 | 3.05 | 3.15 | 2.6 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.8 | 2.05 |
| 6 | 2.25 | 3.9 | 3.1 | 3.1 | 2.6 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 7 | 2.2 | 3.75 | 3.0 | 3.1 | 2.6 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 8 | 3.8 | 3.7 | 2.9 | 3.05 | 2.6 | 2.4 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 9 | 3.7 | 3.65 | 2.9 | 3.05 | 2.6 | 2.35 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 10 | 2.6 | 3.65 | 2.85 | 3.05 | 2.6 | 2.35 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 11 | 2.55 | 3.6 | 2.9 | 3.0 | 2.6 | 2.35 | 2.05 | 2.0 | 1.85 | 1.8 | 1.85 | 2.05 |
| 12 | 2.5 | 3.6 | 4.7 | 3.05 | 2.6 | 2.3 | 2.05 | 2.0 | 1.85 | 1.8 | 1.9 | 2.05 |
| 13 | 2.45 | 3.6 | 8.9 | 3.0 | 2.55 | 2.3 | 2.05 | 2.0 | 1.85 | 1.8 | 1.9 | 2.05 |
| 14 | 2.4 | 3.55 | 5.65 | 2.95 | 2.55 | 2.25 | 2.05 | 2.0 | 1.85 | 1.8 | 1.9 | 2.05 |
| 15 | 2.45 | 3.4 | 4.65 | 2.95 | 2.55 | 2.25 | 2.05 | 2.0 | 1.85 | 1.8 | 1.9 | 2.05 |
| 16 | 2.5 | 4.45 | 5.3 | 2.9 | 2.55 | 2.2 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 17 | 2.45 | 6.55 | 4.65 | 2.9 | 2.55 | 2.2 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 18 | 2.4 | 4.0 | 4.4 | 2.9 | 2.5 | 2.2 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 19 | 2.4 | 3.75 | 4.15 | 2.85 | 2.5 | 2.15 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 20 | 2.4 | 3.7 | 4.0 | 2.85 | 2.5 | 2.15 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 21 | 4.25 | 3.65 | 3.8 | 2.85 | 2.5 | 2.15 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 22 | 3.15 | 3.5 | 3.75 | 2.8 | 2.5 | 2.1 | 2.05 | 1.95 | 1.85 | 1.8 | 1.9 | 2.05 |
| 23 | 2.9 | 3.4 | 3.65 | 2.8 | 2.5 | 2.1 | 2.05 | 1.95 | 1.8 | 1.8 | 1.9 | 2.05 |
| 24 | 2.8 | 3.3 | 3.6 | 2.8 | 2.5 | 2.1 | 2.05 | 1.9 | 1.8 | 1.8 | 1.9 | 2.05 |
| 25 | 2.75 | 3.2 | 3.55 | 2.75 | 2.45 | 2.1 | 2.05 | 1.9 | 1.8 | 1.8 | 1.9 | 2.05 |
| 26 | 2.65 | 3.15 | 3.5 | 2.75 | 2.45 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 2.0 | 2.05 |
| 27 | 2.65 | 3.1 | 3.4 | 2.85 | 2.45 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 2.1 | 2.05 |
| 28 | 2.6 | 3.1 | 3.4 | 2.75 | 2.45 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 2.1 | 2.05 |
| 29 | 2.6 | ....... | 3.6 | 2.7 | 2.45 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 2.1 | 2.05 |
| 30 | 2.5 | ....... | 3.4 | 2.7 | 2.45 | 2.1 | 2.0 | 1.9 | 1.8 | 1.8 | 2.05 | 2.05 |
| 31 | 2.5 | ....... | 3.3 | ....... | 2.45 | ....... | 2.0 | 1.9 | ....... | 1.8 | ....... | 2.05 |

*Station rating table for Santa Ynez River near Santa Barbara, Cal., from January 1 to February 2, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 0.4 | 2.60 | 38 | 3.20 | 154 | 3.80 | 401 |
| 2.10 | 2.8 | 2.70 | 50 | 3.30 | 186 | 3.90 | 451 |
| 2.20 | 6.4 | 2.80 | 65 | 3.40 | 222 | 4.00 | 502 |
| 2.30 | 11.6 | 2.90 | 82 | 3.50 | 263 | | |
| 2.40 | 18.5 | 3.00 | 103 | 3.60 | 306 | | |
| 2.50 | 28 | 3.10 | 126 | 3.70 | 353 | | |

*Station rating table for Santa Ynez River near Santa Barbara, Cal., from February 3 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 1 | 3.00 | 153 | 4.20 | 875 | 5.80 | 2,790 |
| 1.90 | 2 | 3.10 | 184 | 4.30 | 965 | 6.00 | 3,070 |
| 2.00 | 3 | 3.20 | 220 | 4.40 | 1,065 | 6.20 | 3,360 |
| 2.10 | 5 | 3.30 | 265 | 4.50 | 1,175 | 6.40 | 3,650 |
| 2.20 | 10 | 3.40 | 315 | 4.60 | 1,285 | 6.60 | 3,940 |
| 2.30 | 19 | 3.50 | 370 | 4.70 | 1,395 | 6.80 | 4.230 |
| 2.40 | 30 | 3.60 | 430 | 4.80 | 1,510 | 7.00 | 4,520 |
| 2.50 | 44 | 3.70 | 495 | 4.90 | 1,630 | 7.50 | 5,245 |
| 2.60 | 60 | 3.80 | 565 | 5.00 | 1,750 | 8.00 | 5,970 |
| 2.70 | 79 | 3.90 | 635 | 5.20 | 1,990 | 8.50 | 6,695 |
| 2.80 | 100 | 4.00 | 710 | 5.40 | 2,250 | 9.00 | 7,420 |
| 2.90 | 125 | 4.10 | 790 | 5.60 | 2,510 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during January, February, and March, 1906.

*Estimated monthly discharge of Santa Ynez River near Santa Barbara, Cal., for 1905.*

[Drainage area, 207 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 635 | 6.4 | 73.8 | 4,538 | 0.357 | 0.412 |
| February | 6,550 | 28.0 | 905 | 50,260 | 4.37 | 4.55 |
| March | 7,275 | 112 | 797 | 49,010 | 3.85 | 4.44 |
| April | 242 | 79 | 143 | 8,509 | .691 | .771 |
| May | 100 | 37 | 52.5 | 3,228 | .254 | .293 |
| June | 30 | 5 | 15.9 | 946 | .077 | .086 |
| July | 4 | 3 | 3.8 | 234 | .018 | .021 |
| August | 3 | 2 | 2.6 | 160 | .013 | .015 |
| September | 2 | 1 | 1.4 | 83 | .0068 | .0076 |
| October | 1 | 1 | 1.0 | 61 | .0048 | .0055 |
| November | 5 | 1 | 2.1 | 125 | .010 | .011 |
| December | 4 | 4 | 4.0 | 246 | .019 | .022 |
| The year | 7,275 | 1.0 | 167 | 117,400 | .806 | 10.63 |

## SANTA MARIA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Santa Maria River drains the northern slope of the San Rafael Mountains and a limited area of foothill country to the north of this range. It flows in a westerly direction, finally discharging its waters into the Pacific Ocean at Guadalupe about 25 miles south of San Luis Obispo. Its flow is torrential in character, subject to floods of short duration during the rainy period, but being practically dry during the summer months. It has numerous tributaries, the most important of which is the Sisquoc, which enters it about 12 miles above the town of Santa Maria. The gaging station is located about 25 miles above the town of Santa Maria and above most of its important tributaries. The country throughout this basin consists of rolling foothills, with the exception of the higher elevations of the San Rafael Mountains, which reach an elevation of 6,000 to 8,000 feet. The river breaks from the foothills at the point where it is joined by the Sisquoc and flows through the flat country of the Santa Maria Valley for a distance of about 25 miles until it joins the Pacific Ocean at Guadalupe. The formation throughout this basin is of shale, sandstone, and conglomerate, with a good covering of heavy clay soil. There is considerable growth of timber on the higher elevations of the San Rafael Mountains, but over most of the area the growth of timber is light, with large areas of brush and grass. The pasturage of stock is carried on extensively throughout the basin. There are no diversions along this stream for irrigation although tunnel work has been attempted above Santa Maria for the development of underground water, with poor results. There are numerous wells in the vicinity of Santa Maria which produce considerable water for the irrigation of land in that locality, the soil being very deep and of exceptional quality, susceptible to the highest state of cultivation. The mean precipitation in this drainage basin is probably about 25 inches. The greatest rainfall occurs on the lower elevations near the coast. The higher elevations receive some snowfall, which melts early in the spring and does not tend to keep up the flow of the stream through the summer.

### SANTA MARIA RIVER NEAR SANTA MARIA, CAL.

This station was established October 22, 1903, by W. B. Clapp. It is located near the ranch house on Dutard's ranch, 21 miles above Santa Maria, Cal., a station on the Pacific Coast Railway. It is reached by driving from Santa Maria.

The channel is slightly curved for 300 feet above and curved for 1,000 feet below the station. The water is swift at medium and flood stages.

The right bank is high and rocky, and not liable to overflow. The left bank is low, covered with scattering poplar trees, but not liable to overflow. The bed of the stream is composed of sand and gravel. A portion of the bed is covered with a light growth of low brush. The channel is not liable to much change.

At low and medium water discharge measurements are made with meter by wading. During high water velocities are measured by means of floats. For this purpose two wires are stretched across the stream 254 feet apart. The rise in the channel above the upper wire is 0.40 foot in 100 feet, and below the upper wire it is 0.57 foot in 100 feet. The initial points for soundings are blazes on the poplar trees on the left bank, to which the wires are attached.

The gage is an inclined staff, fastened to a rock ledge at the right bank. During 1905 the gage was read once each day by James A. Thompson. The bench mark is a spike driven near the ground into the south side of the poplar tree to which the upper wire is fastened on the left bank of the stream; elevation, 9.65 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Santa Maria River near Santa Maria, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 2.... | E. C. La Rue........................ | 34 | 30 | 2.67 | 3.30 | 80 |
| March 6........ | O. W. Peterson...................... | 24 | 22 | 2.14 | 2.70 | 47 |
| March 21...... | .....do................................ | 40 | 28 | 2.39 | 1.20 | 67 |

*Daily gage height, in feet, of Santa Maria River near Santa Maria, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 2.6 | 2.05 | 0.9 | 0.8 | 0.65 | 0.7 | 0.6 | 0.5 | 0.6 | 0.75 | 0.85 |
| 2 | 3.0 | 3.8 | 2.05 | .9 | 1.1 | .65 | .7 | .6 | .5 | .6 | .75 | .85 |
| 3 | 2.9 | 6.0 | 2.05 | .9 | 1.0 | .7 | .7 | .6 | .5 | .6 | .75 | .85 |
| 4 | 2.7 | 5.95 | 2.05 | .9 | .85 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 5 | 2.7 | 5.0 | 2.05 | .9 | .8 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 6 | 2.7 | 5.0 | 2.7 | .9 | .8 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 7 | 2.7 | 3.5 | 2.65 | .85 | .8 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 8 | 2.7 | 3.2 | 2.5 | .85 | 1.2 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 9 | 2.7 | 3.0 | 2.35 | .85 | 1.25 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 10 | 2.7 | 2.9 | 2.2 | .85 | 1.0 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 11 | 2.7 | 2.85 | 2.2 | .85 | .9 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 12 | 2.65 | 2.8 | 2.2 | .85 | .9 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 13 | 2.65 | 2.75 | 10.0 | .85 | .85 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 14 | 2.65 | 2.75 | [a]5.0 | .85 | .85 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 15 | 2.65 | 2.65 | [a]4.5 | .85 | .8 | .7 | .7 | .6 | .5 | .65 | .75 | .8 |
| 16 | 2.7 | 3.0 | [a]4.0 | .85 | .8 | .7 | .7 | .6 | .5 | .7 | .75 | .8 |
| 17 | 2.65 | 4.1 | [a]4.0 | .85 | .8 | .7 | .65 | .6 | .5 | .7 | .75 | .8 |
| 18 | 2.65 | 5.95 | [a]3.5 | .85 | .8 | .7 | .65 | .6 | .5 | .7 | .75 | .8 |
| 19 | 2.65 | 4.0 | [a]3.5 | .85 | .8 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 20 | 2.65 | 2.6 | [a]2.0 | .85 | .8 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 21 | 3.0 | 2.4 | 1.2 | .85 | .8 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 22 | 2.8 | 2.35 | 1.1 | .85 | .75 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 23 | 2.7 | 2.25 | 1.05 | .85 | .75 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 24 | 2.7 | 2.15 | 1.05 | .85 | .7 | .7 | .65 | .6 | .5 | .7 | .75 | .85 |
| 25 | 2.65 | 2.15 | 1.0 | .85 | .65 | .7 | .65 | .55 | .7 | .75 | .75 | .85 |
| 26 | 2.65 | 2.15 | 1.0 | .85 | .6 | .7 | .65 | .55 | .7 | .75 | .75 | .8 |
| 27 | 2.65 | 2.1 | 1.0 | .85 | .6 | .7 | .65 | .55 | .65 | .75 | .75 | .8 |
| 28 | 2.65 | 2.05 | 1.2 | .85 | .6 | .7 | .65 | .55 | .6 | .75 | .85 | .8 |
| 29 | 2.65 | ....... | 1.2 | .8 | .6 | .7 | .65 | .5 | .6 | .75 | .85 | .85 |
| 30 | 2.6 | ....... | 1.1 | .8 | .65 | .7 | .6 | .5 | .6 | .75 | .85 | .85 |
| 31 | 2.6 | ....... | 1.0 | ....... | .65 | ....... | .6 | .5 | ....... | .75 | ....... | .85 |

[a] Estimated.

*Station rating table for Santa Maria River near Santa Maria, Cal., from January 1 to February 2, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 1 | 2.60 | 13 | 3.20 | 67 | 3.70 | 178 |
| 2.10 | 2 | 2.70 | 18 | 3.30 | 82 | 3.80 | 213 |
| 2.20 | 3 | 2.80 | 25 | 3.40 | 100 | 3.90 | 250 |
| 2.30 | 5 | 2.90 | 33 | 3.50 | 122 | 4.00 | 290 |
| 2.40 | 7 | 3.00 | 43 | 3.60 | 148 | 4.10 | 330 |
| 2.50 | 10 | 3.10 | 54 | | | | |

*Station rating table for Santa Maria River near Santa Maria, Cal., from February 3 to March 12, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 1 | 2.70 | 48 | 3.70 | 285 | 4.70 | 915 |
| 1.80 | 2 | 2.80 | 59 | 3.80 | 335 | 4.80 | 990 |
| 1.90 | 3 | 2.90 | 72 | 3.90 | 385 | 4.90 | 1,065 |
| 2.00 | 5 | 3.00 | 87 | 4.00 | 440 | 5.00 | 1,140 |
| 2.10 | 8 | 3.10 | 105 | 4.10 | 500 | 5.20 | 1,290 |
| 2.20 | 12 | 3.20 | 125 | 4.20 | 565 | 5.40 | 1,440 |
| 2.30 | 17 | 3.30 | 147 | 4.30 | 630 | 5.60 | 1,595 |
| 2.40 | 23 | 3.40 | 173 | 4.40 | 700 | 5.80 | 1,755 |
| 2.50 | 30 | 3.50 | 205 | 4.50 | 770 | 6.00 | 1,915 |
| 2.60 | 38 | 3.60 | 242 | 4.60 | 840 | | |

*Stationrating table for Santa Maria River near Santa Maria, Cal., from March 13 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 1 | 2.00 | 250 | 4.00 | 1,070 | 7.00 | 3,260 |
| 0.60 | 3 | 2.10 | 280 | 4.20 | 1,185 | 7.20 | 3,450 |
| 0.70 | 6 | 2.20 | 310 | 4.40 | 1,305 | 7.40 | 3,650 |
| 0.80 | 10 | 2.30 | 340 | 4.60 | 1,435 | 7.60 | 3,870 |
| 0.90 | 18 | 2.40 | 375 | 4.80 | 1,565 | 7.80 | 4,100 |
| 1.00 | 31 | 2.50 | 410 | 5.00 | 1,700 | 8.00 | 4,350 |
| 1.10 | 47 | 2.60 | 445 | 5.20 | 1,840 | 8.20 | 4,640 |
| 1.20 | 65 | 2.70 | 480 | 5.40 | 1,980 | 8.40 | 4,970 |
| 1.30 | 84 | 2.80 | 520 | 5.60 | 2,130 | 8.60 | 5,340 |
| 1.40 | 105 | 2.90 | 560 | 5.80 | 2,280 | 8.80 | 5,750 |
| 1.50 | 127 | 3.00 | 600 | 6.00 | 2,430 | 9.00 | 6,200 |
| 1.60 | 150 | 3.20 | 690 | 6.20 | 2,585 | 10.00 | 10,000 |
| 1.70 | 175 | 3.40 | 780 | 6.40 | 2,745 | | |
| 1.80 | 200 | 3.60 | 875 | 6.60 | 2,910 | | |
| 1.90 | 225 | 3.80 | 975 | 6.80 | 3,080 | | |

NOTE.—The upper part of the rating curve is based on slope measurements.

*Estimated monthly discharge of Santa Maria River near Santa Maria, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 122 | 13 | 22.5 | 1,384 |
| February | 1,915 | 6 | 361 | 20,050 |
| March | 10,000 | 6 | 574 | 35,290 |
| April | 18 | 10 | 14.5 | 863 |
| May | 74 | 3 | 15.5 | 953 |
| June | 6 | 4 | 5.9 | 352 |
| July | 6 | 3 | 5.0 | 307 |
| August | 3 | 1 | 2.7 | 166 |
| September | 6 | 1 | 1.6 | 96 |
| October | 8 | 3 | 5.4 | 332 |
| November | 14 | 8 | 8.6 | 512 |
| December | 14 | 10 | 11.7 | 719 |
| The year | 10,000 | 1 | 85.7 | 61,020 |

NOTE.—Estimates during high-water periods are approximate only.

## SALINAS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Arroyo Seco is the most northern tributary of any size of the Salinas River, and rises on the slopes of the highest portion of the Santa Lucia Range, one of the ranges that go to make up the Coast Range of California extending in a general southeast direction from San Francisco Bay. The upper valleys of this stream are far back in the range, surrounded by high mountains.

The drainage area of the Arroyo Seco is almost entirely made up of sharp ridges and V-shaped canyons. The western portion is well covered with brush and trees of medium size. Toward the east this growth decreases until at the Salinas Valley the country is bare. The stream beds of this area fall rapidly, the Arroyo Seco rising at an elevation of nearly 6,000 feet and discharging into the Salinas at an elevation of 170 feet.

Below the gaging station several canals divert water from this stream before it reaches the broad wash of sand and gravel on the flat floor of the Salinas Valley, into which it sinks during the dry season and from which it receives its name "Arroyo Seco."

There are five reservoir sites on the stream and its tributaries, of more or less value as possible storage reservoirs, that have already been surveyed.

This portion of the range undoubtedly receives as great rainfall as any other locality in this region, and it is estimated that the average annual precipitation is from 30 to 50 inches and falls almost entirely in the form of rain.

### ARROYO SECO NEAR SOLEDAD, CAL.

The original gaging station on this stream was established by W. W. Cockins, jr., in December, 1900, at Foster's ranch, near Piney, Cal. High water of January, 1901, enlarged an old side channel, dividing the stream into two channels. The gaging station was then removed to Pettitt's ranch, 4 miles below the old station.

The channel is straight for 400 feet above and below the station. The right bank is low, wooded, and subject to overflow. The left bank is high, rocky, and not subject to overflow. The bed of the stream is composed of gravel and is not subject to much change.

Discharge measurements are made by means of a cable and car. The initial point for soundings is on the left bank.

The gage rod is in two sections. The low-water section is placed 400 feet above the cable on the right bank; the high-water section is fastened to a sycamore tree above the cable and about 250 feet from the right bank of the low-water channel. During 1905 the gage was read by Mrs. Charles Pettitt. The bench mark is a spike in the tree to which the high-water section of the gage is fastened; elevation, 15.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Arroyo Seco River near Soledad, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 31 | La Rue and Pettitt | 122 | 123 | 1.04 | 5.91 | 128 |
| February 2 | Charles Pettitt | 130 | 410 | 3.84 | 8.80 | 1,574 |
| February 3 | do | 124 | 281 | 3.05 | 7.50 | 856 |
| February 5 | do | 125 | 254 | 3.06 | 7.35 | 778 |
| February 16 | do | 125 | 212 | 2.29 | 6.82 | 486 |
| February 17 | do | 133 | 423 | 4.32 | 8.95 | 1,829 |
| March 11 | do | 120 | 135 | 1.05 | 5.90 | 142 |
| March 13 | do | 133 | 484 | 4.65 | 10.05 | 2,253 |
| March 16 | do | 128 | 327 | 4.02 | 8.00 | 1,315 |
| March 17 | do | 128 | 288 | 2.91 | 7.50 | 838 |
| March 19 | do | 133 | 455 | 4.90 | 9.30 | 2,233 |
| March 29 | do | 125 | 248 | 2.36 | 7.05 | 585 |
| April 9 | do | 123 | 158 | 1.57 | 6.10 | 248 |
| April 16 | do | 123 | 150 | 1.40 | 6.09 | 210 |
| April 19 | do | 123 | 151 | 1.59 | 6.16 | 240 |
| April 29 | do | 122 | 117 | 1.07 | 5.95 | 125 |
| May 7 | do | 130 | 351 | 3.75 | 8.30 | 1,317 |
| May 8 | do | 125 | 241 | 2.86 | 7.12 | 689 |
| May 28 | do | 123 | 107 | 1.15 | 5.93 | 123 |
| June 4 | do | 123 | 113 | 1.03 | 5.83 | 116 |
| June 12 | do | 122 | 95 | .82 | 5.75 | 78 |
| June 18 | do | 122 | 89 | .76 | 5.70 | 68 |
| Do | do | 48 | 63 | 1.24 | 5.70 | 78 |
| June 24 | do | 43 | 54 | 1.00 | 5.62 | 54 |
| July 3 | do | 41 | 49 | .80 | 5.55 | 39 |
| July 9 | do | 40 | 46 | .61 | 5.48 | 28 |
| July 15 | do | 38 | 42 | .57 | 5.45 | 24 |
| July 23 | do | 35 | 39 | .54 | 5.42 | 21 |
| July 29 | do | 36 | 37 | .43 | 5.40 | 16 |
| August 6 | do | 34 | 35 | .37 | 5.38 | 13 |
| August 10 | do | 27 | 24 | .33 | 5.33 | 8 |

*Daily gage height, in feet, of Arroyo Seco River near Soledad, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.1 | 8.4 | 6.15 | 6.5 | 5.9 | 5.85 | 5.6 | 5.4 | 5.2 | 5.25 | 5.35 | 5.65 |
| 2 | 5.9 | 8.6 | 6.1 | 6.45 | 6.55 | 5.85 | 5.55 | 5.4 | 5.2 | 5.25 | 5.35 | 5.6 |
| 3 | 5.8 | 7.45 | 6.05 | 6.4 | 6.2 | 5.8 | 5.5 | 5.4 | 5.2 | 5.25 | 5.35 | 5.55 |
| 4 | 5.75 | 7.4 | 6.0 | 6.35 | 6.05 | 5.85 | 5.5 | 5.4 | 5.2 | 5.25 | 5.35 | 5.5 |
| 5 | 5.7 | 7.35 | 6.0 | 6.3 | 6.0 | 5.8 | 5.5 | 5.4 | 5.2 | 5.25 | 5.35 | 5.5 |
| 6 | 5.7 | 7.2 | 6.0 | 6.25 | 6.0 | 5.8 | 5.5 | 5.4 | 5.2 | 5.25 | 5.35 | 5.5 |
| 7 | 5.65 | 7.0 | 5.95 | 6.25 | 7.9 | 5.8 | 5.5 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 8 | 5.6 | 6.8 | 5.9 | 6.2 | 7.2 | 5.8 | 5.5 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 9 | 5.8 | 6.65 | 5.9 | 6.1 | 6.8 | 5.8 | 5.5 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 10 | 6.0 | 6.55 | 5.9 | 6.15 | 6.6 | 5.8 | 5.5 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 11 | 5.9 | 6.45 | 5.9 | 6.1 | 6.45 | 5.75 | 5.45 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 12 | 5.8 | 6.35 | 6.55 | 6.1 | 6.4 | 5.75 | 5.45 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 13 | 5.8 | 6.3 | 10.1 | 6.1 | 6.3 | 5.7 | 5.45 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 14 | 5.9 | 6.25 | 7.85 | 6.1 | 6.2 | 5.7 | 5.45 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 15 | 5.9 | 6.2 | 7.5 | 6.05 | 6.2 | 5.7 | 5.45 | 5.35 | 5.2 | 5.25 | 5.35 | 5.5 |
| 16 | 6.95 | 6.8 | 8.0 | 6.1 | 6.15 | 5.7 | 5.45 | 5.3 | 5.25 | 5.25 | 5.35 | 5.5 |
| 17 | 6.3 | 8.5 | 7.6 | 6.05 | 6.1 | 5.7 | 5.45 | 5.3 | 5.25 | 5.3 | 5.4 | 5.5 |
| 18 | 6.1 | 7.45 | 7.3 | 6.0 | 6.1 | 5.7 | 5.45 | 5.3 | 5.25 | 5.3 | 5.4 | 5.55 |
| 19 | 6.2 | 7.05 | 9.1 | 6.2 | 6.05 | 5.7 | 5.45 | 5.3 | 5.25 | 5.3 | 5.4 | 5.6 |
| 20 | 6.1 | 6.9 | 7.6 | 6.1 | 6.05 | 5.7 | 5.4 | 5.3 | 5.2 | 5.3 | 5.4 | 5.6 |
| 21 | 6.5 | 6.6 | 7.35 | 6.05 | 6.0 | 5.7 | 5.4 | 5.3 | 5.2 | 5.3 | 5.4 | 5.6 |
| 22 | 6.2 | 6.5 | 7.1 | 6.05 | 6.0 | 5.65 | 5.4 | 5.3 | 5.2 | 5.3 | 5.4 | 5.6 |
| 23 | 6.1 | 6.4 | 6.9 | 6.0 | 5.95 | 5.65 | 5.4 | 5.3 | 5.2 | 5.35 | 5.4 | 5.6 |
| 24 | 6.05 | 6.35 | 6.75 | 6.0 | 5.9 | 5.65 | 5.4 | 5.3 | 5.2 | 5.35 | 5.5 | 5.55 |
| 25 | 6.1 | 6.3 | 6.7 | 6.0 | 5.9 | 5.6 | 5.4 | 5.3 | 5.2 | 5.35 | 5.65 | 5.55 |
| 26 | 6.0 | 6.25 | 6.65 | 6.0 | 5.95 | 5.6 | 5.4 | 5.3 | 5.2 | 5.35 | 5.5 | 5.5 |
| 27 | 6.0 | 6.2 | 6.55 | 6.0 | 5.95 | 5.6 | 5.4 | 5.25 | 5.2 | 5.35 | 5.5 | 5.5 |
| 28 | 6.0 | 6.2 | 6.5 | 6.0 | 5.95 | 5.6 | 5.4 | 5.25 | 5.2 | 5.35 | 5.75 | 5.5 |
| 29 | 5.95 | ....... | 7.5 | 5.95 | 5.9 | 5.6 | 5.4 | 5.25 | 5.2 | 5.35 | 5.6 | 5.55 |
| 30 | 5.9 | ....... | 6.65 | 5.95 | 5.9 | 5.6 | 5.4 | 5.25 | 5.2 | 5.35 | 5.9 | 5.5 |
| 31 | 5.9 | ....... | 6.6 | ....... | 5.85 | ....... | 5.4 | 5.25 | ....... | 5.3 | ....... | 5.5 |

*Station rating table for Arroyo Seco River near Soledad, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.20 | 2 | 6.30 | 265 | 7.40 | 800 | 9.00 | 1,900 |
| 5.30 | 6 | 6.40 | 305 | 7.50 | 860 | 9.20 | 2,060 |
| 5.40 | 15 | 6.50 | 345 | 7.60 | 920 | 9.40 | 2,225 |
| 5.50 | 30 | 6.60 | 390 | 7.70 | 980 | 9.60 | 2,400 |
| 5.60 | 50 | 6.70 | 435 | 7.80 | 1,045 | 9.80 | 2,580 |
| 5.70 | 70 | 6.80 | 480 | 7.90 | 1,110 | 10.00 | 2,760 |
| 5.80 | 95 | 6.90 | 530 | 8.00 | 1,175 | 10.20 | 2,945 |
| 5.90 | 125 | 7.00 | 580 | 8.20 | 1,310 | 10.40 | 3,135 |
| 6.00 | 155 | 7.10 | 635 | 8.40 | 1,450 | | |
| 6.10 | 190 | 7.20 | 690 | 8.60 | 1,595 | | |
| 6.20 | 225 | 7.30 | 745 | 8.80 | 1,745 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 31 discharge measurements made during 1905. It is well defined between gage heights 5.3 feet and 9.5 feet.

*Estimated monthly discharge of Arroyo Seco River near Soledad, Cal., for 1905*

[Drainage area, 215 square miles.]

| Month | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 555 | 50 | 160 | 9,838 | 0.744 | 0.858 |
| February | 1,595 | 225 | 556 | 30,880 | 2.59 | 2.70 |
| March | 2,850 | 125 | 586 | 36,030 | 2.73 | 3.15 |
| April | 345 | 140 | 202 | 12,020 | .940 | 1.05 |
| May | 1,110 | 110 | 246 | 15,130 | 1.14 | 1.31 |
| June | 110 | 50 | 75.6 | 4,499 | .352 | .393 |
| July | 50 | 15 | 22.8 | 1,402 | .106 | .122 |
| August | 15 | 4 | 8.6 | 529 | .040 | .046 |
| September | 4 | 2 | 2.3 | 137 | .011 | .012 |
| October | 10 | 4 | 6.1 | 375 | .028 | .032 |
| November | 125 | 10 | 22.4 | 1,333 | .104 | .116 |
| December | 60 | 30 | 36.5 | 2,245 | .170 | .196 |
| The year | 2,850 | 2 | 160 | 114,400 | .746 | 9.98 |

## MISCELLANEOUS MEASUREMENTS IN SOUTHERN CALIFORNIA.

The following is a list of miscellaneous discharge measurements made in Riverside and San Diego counties during 1905:

*Cottonwood Creek near Jamul, Cal.*—This stream rises in the Coast Range in the southeastern part of San Diego County, and flowing in a southwesterly direction discharges into Tiajuana River below the California-Mexico boundary line. The following discharge measurements were made at the Barrett Dam. The gage is a 2-by-4 inch vertical timber painted white and graduated to feet and hundredths. It is nailed to the timber wall on the left bank of the stream at the concrete dam. No bench mark was established, as the zero of the rod is set level with the top of the concrete dam.

November 18: Width, 2.7 feet; area, 0.5 square foot; mean velocity, 1.00 foot per second; discharge, 0.5 second-foot.

December 14: Width, 5 feet; area, 1.6 square feet; mean velocity, 0.69 foot per second; gage height, 0.05 foot; discharge, 1.1 second-feet.

*Temecula Creek near Temecula, Cal.*—This creek rises in the Coast Range in the southeastern part of Riverside County, and flowing in a southwesterly direction discharges into the Pacific Ocean near Oceanside, Cal. The following discharge measurements were made on this stream during 1905:

At Pauba dam site, 12 miles above Temecula, Cal., November 14: Width, 7.5 feet; area, 2 square feet; mean velocity, 1.25 feet per second; discharge, 2.5 second-feet.

At Temecula Bridge, 1 mile below Temecula, Cal., November 14: Width, 11 feet; area, 5.4 square feet; mean velocity, 1.07 feet per second; gage height, 3.10 feet; discharge, 5.8 second-feet.

December 30: Width, 9 feet; area, 3.5 square feet; mean velocity, 1.32 feet per second; gage height, 2.98 feet; discharge, 4.6 second-feet.

A gage was placed on the Temecula Bridge consisting of a 2-by-6 inch vertical timber, graduated to feet and hundredths. It is fastened to the downstream pier near the right bank of the stream. No bench mark was established.

*San Diego River near Lakeside, Cal.*—This stream rises in the Coast Range in the eastern part of San Diego County, and flowing in a southwesterly direction discharges in the Pacific Ocean near San Diego, Cal. A measurement was made at the concrete dam of the San Diego Flume Company, at the head of that company's flume.

November 23: Width, 6 feet; area, 1.0 square foot; mean velocity, 1.90 feet per second; discharge, 1.9 second-feet.

*Santa Ysabel River near San Pasqual, Cal.*—This stream rises in the eastern part of San Diego County, and flowing in a southwesterly direction discharges into the Pacific Ocean near Del Mar, Cal. The lower portion of this river is known as the San Dieguito River. The following measurements were made during 1905 at the upper end of the San Pasqual Valley. The gage consists of a 2-by-4 inch inclined timber, graduated to feet and hundredths, and bolted to a large granite bowlder on the left bank of the stream. The bench mark is on top of the bowlder to which the gage is bolted. It is marked with a circle of white paint. Its elevation is 11.66 feet above the zero of the gage.

November 21: Width, 5 feet; area, 2.2 square feet; mean velocity, 2.05 feet per second; discharge, 4.5 second-feet.

November 28: Width, 83 feet; area, 24 square feet; mean velocity, 1.70 feet per second; gage height, 3.72 feet; discharge, 41 second-feet.

December 21: Width, 24 feet; area, 7.2 square feet; mean velocity, 1.44 feet per second; gage height, 3.55 feet; discharge, 10.4 second-feet.

*Sweetwater River near Descanso, Cal.*—This stream rises in the southeastern part of San Diego County, and flowing in a southwesterly direction discharges into San Diego Bay near National City. The following measurements were made during 1905, 1 mile below Descanso. The gage is a 2-by-6 inch vertical timber, graduated to feet and hundredths. It is bolted to a granite bowlder on the left bank of the stream. The bench mark is the highest point on the large bowlder to which the gage is fastened. It is marked with a circle of white paint, and its elevation is 5 feet above the zero of the gage.

September 11: Measured by Weir; discharge, 0.37 second-foot.

November 21: Width, 3 feet; area, 0.9 square foot; mean velocity, 1.22 feet per second; gage height, 3.54 feet; discharge, 1.1 second-feet.

December 10: Width, 6 feet; area, 1.9 square feet; mean velocity, 1.35 feet per second; gage height, 3.62 feet; discharge, 2.5 second-feet.

## SAN FRANCISCO BAY DRAINAGE BASIN.

### GENERAL FEATURES.

Sacramento River, rising in northern California and flowing south, and San Joaquin River, rising in the southern Sierras and flowing north, drain the western slope of the Sierra Nevada and the eastern slope of the Coast Range north of San Francisco. They meet near Suisun Bay, finally discharging their waters into the Pacific Ocean through San Francisco Bay.

### SACRAMENTO RIVER.

#### DESCRIPTION OF RIVER.

Sacramento River is the principal river of California, and drains all of the territory south of Mount Shasta and between the Coast Range and Trinity Range on the west and the Sierra Nevadas on the east. The portion of the drainage basin above the gaging station which is located near Red Bluff, Cal., extends from the Trinity Mountains on the west to Warner Mountains near the California-Nevada State line on the east. The watershed on the west from the Trinity Mountains is comparatively narrow, being only from 10 to 35 miles in width, and furnishes a very small proportion of the discharge of this river, but from the east Pit River, which is the most important tributary, drains a large area extending about 120 miles east from the Sacramento River and between Mount Shasta on the north and Lassen Peak on the south. The greater portion of this basin is composed of lava, and shows other evidences of volcanic activity, such as volcanic cones and craters. Nearly all the streams tributary to Pit River have their origin in large springs, many of which discharge several hundred second-feet. The most important tributary of the Pit is the McCloud

River, draining the southeastern slope of Mount Shasta. It derives its waters principally from the melting of the snow on the high elevations of this mountain. The western portion of the watershed extending along the Trinity Range is well timbered, as is also that portion of the drainage area in the Sierra Nevadas lying between Mount Shasta and Lassen Peak. Farther east, however, there is little or no forest covering, and the country is used extensively for pasturage. The rainfall is very unequally distributed, varying from less than 10 inches in the eastern portion of the basin to 50 inches along the northern and western portion. Below the gaging station the river enters the Sacramento Valley, through which it flows on a comparatively light grade until it reaches Suisun Bay. During the winter months, when the Sacramento and its tributaries are in flood, large areas of the Sacramento Valley are overflowed. The floods which occur in the latter part of the rainy season, and after these large overflow areas or basins are filled, cause great damage in the lower portion of the valley.

## SACRAMENTO RIVER NEAR RED BLUFF, CAL.

The gaging station at Jellys Ferry, which is located about 12 miles above the town of Red Bluff, was established April 30, 1895. The right bank of the river is high, but the left bank is liable to overflow when the river rises above the 25-foot mark. The river has been known to reach the 35-foot mark. Because of the liability to overflow it was deemed advisable to select a new gaging station, where the water at flood stage could be more confined. A point in Iron Canyon, where the river had been gaged by the State engineering department in 1879 and by commissioner of public works in 1893–94, was chosen as a new gaging station.

The river at this point in lower portion of Iron Canyon, 4 miles above Red Bluff, has a direct course for 2 or 3 miles. The width between banks at low water is about 500 feet. The depth of water at low stages averages 6 feet, with a maximum depth of 9 feet. The banks are steep and firm. The river flows in a bed of coarse gravel and cobbles, with here and there a small bowlder. The bed rock is lava.

Discharge measurements are made from a cable 600 feet in span, which is anchored in the lava rock which forms the wall of the canyon.

The river stage rod used by commissioner of public works was still in place, and has been used in making river height observations since January 28, 1902, the date upon which the observations were begun. A second set of gage rods were placed on the right bank 3,200 feet below the gaging station January 1, 1904, as no observer could be obtained to continue readings of the station gage. By synchronous readings of the lower gages and the station gage the actual readings for this lower gage have been converted into equivalent readings for the station gage. On September 28, 1904, it was necessary to move the lower gage rods to the left bank about 4,000 feet below the gaging station. The actual readings of this set of gage rods have also been converted into equivalent readings for the station gage. During 1905 the gage was read twice each day by Fred Weeks. All reported gage heights are those determined for the station gage. Bench marks were established as follows: (1) A nail in the crotch of sycamore tree to which the third section of the gage is fastened; elevation, 8.355 feet. (2) Point of rock marked with heavy ring of white paint 7.1 feet south of eyebolt on left bank; elevation, 47.75 feet. (3) A point marked with ring of white paint 45 feet north of 10-foot mark on cable; elevation 38.01 feet. (4) Eye-bolt on left bank; elevation 44.80 feet. (5) Point on rock under left cable support marked with circle of white paint; elevation, 27.59 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Sacramento River near Red Bluff, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| August 5 | Peterson and Lee | 448 | 3,520 | 1.48 | 1.49 | 5,208 |
| August 30 | C. H. Lee | 497 | 3,404 | 1.48 | 1.34 | 5,043 |

*Daily gage height, in feet, of Sacramento River near Red Bluff, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.2 | 8.9 | 4.85 | 8.05 | 4.05 | 3.0 | 1.95 | 1.45 | 1.25 | 1.3 | 1.3 | 1.75 |
| 2 | 6.15 | 15.85 | 4.75 | 7.8 | 4.3 | 3.0 | 1.95 | 1.45 | 1.25 | 1.3 | 1.3 | 1.55 |
| 3 | 4.8 | 13.3 | 4.6 | 7.55 | 4.1 | 3.0 | 1.9 | 1.45 | 1.25 | 1.3 | 1.3 | 1.55 |
| 4 | 4.7 | 11.35 | 4.55 | 7.1 | 3.9 | 3.0 | 1.9 | 1.45 | 1.25 | 1.25 | 1.3 | 1.55 |
| 5 | 4.3 | 10.15 | 4.5 | 6.8 | 3.7 | 3.0 | 1.9 | 1.45 | 1.25 | 1.25 | 1.3 | 1.55 |
| 6 | 4.0 | 8.95 | 4.4 | 6.45 | 3.7 | 3.0 | 1.8 | 1.45 | 1.25 | 1.25 | 1.4 | 1.55 |
| 7 | 3.75 | 8.15 | 4.3 | 6.25 | 4.1 | 2.85 | 1.75 | 1.4 | 1.25 | 1.3 | 1.4 | 1.55 |
| 8 | 3.55 | 7.4 | 4.2 | 5.95 | 5.5 | 2.9 | 1.7 | 1.4 | 1.25 | 1.3 | 1.4 | 1.55 |
| 9 | 3.45 | 6.8 | 4.15 | 5.75 | 4.95 | 2.85 | 1.75 | 1.4 | 1.25 | 1.3 | 1.4 | 1.55 |
| 10 | 3.35 | 6.4 | 4.05 | 5.45 | 4.6 | 2.85 | 1.75 | 1.4 | 1.25 | 1.3 | 1.4 | 1.55 |
| 11 | 3.2 | 6.0 | 4.05 | 5.25 | 3.85 | 2.7 | 1.7 | 1.4 | 1.25 | 1.3 | 1.4 | 1.55 |
| 12 | 3.1 | 5.55 | 4.9 | 5.0 | 4.15 | 2.7 | 1.7 | 1.3 | 1.25 | 1.3 | 1.45 | 1.55 |
| 13 | 3.85 | 5.2 | 10.25 | 4.85 | 4.15 | 2.65 | 1.7 | 1.3 | 1.25 | 1.25 | 1.45 | 1.7 |
| 14 | 14.35 | 4.9 | 13.55 | 4.75 | 3.9 | 2.6 | 1.7 | 1.3 | 1.25 | 1.3 | 1.45 | 1.55 |
| 15 | 9.8 | 4.75 | 11.15 | 4.7 | 3.85 | 2.55 | 1.7 | 1.3 | 1.25 | 1.3 | 1.45 | 1.55 |
| 16 | 9.5 | 4.55 | 10.7 | 5.45 | 3.85 | 2.5 | 1.7 | 1.3 | 1.25 | 1.3 | 1.45 | 1.55 |
| 17 | 7.95 | 4.55 | 9.7 | 4.95 | 4.0 | 2.4 | 1.7 | 1.3 | 1.25 | 1.3 | 1.45 | 1.7 |
| 18 | 6.85 | 4.5 | 8.25 | 4.75 | 3.85 | 2.35 | 1.6 | 1.3 | 1.25 | 1.3 | 1.45 | 1.8 |
| 19 | 7.3 | 5.25 | 11.4 | 5.2 | 3.75 | 2.35 | 1.6 | 1.3 | 1.25 | 1.3 | 1.45 | 2.1 |
| 20 | 7.05 | 8.2 | 10.3 | 5.0 | 3.6 | 2.3 | 1.55 | 1.3 | 1.25 | 1.3 | 1.55 | 2.1 |
| 21 | 9.2 | 7.95 | 11.1 | 4.85 | 3.5 | 2.3 | 1.55 | 1.3 | 1.25 | 1.3 | 1.55 | 1.9 |
| 22 | 14.3 | 7.2 | 11.2 | 4.7 | 3.4 | 2.25 | 1.55 | 1.3 | 1.25 | 1.3 | 1.55 | 1.7 |
| 23 | 20.3 | 6.6 | 9.0 | 4.55 | 3.35 | 2.25 | 1.55 | 1.3 | 1.25 | 1.3 | 1.55 | 1.55 |
| 24 | 15.55 | 6.0 | 9.8 | 4.4 | 3.3 | 2.2 | 1.5 | 1.3 | 1.25 | 1.3 | 1.55 | 1.55 |
| 25 | 15.45 | 5.7 | 8.45 | 4.4 | 3.2 | 2.25 | 1.5 | 1.25 | 1.25 | 1.3 | 1.55 | 1.55 |
| 26 | 12.75 | 5.45 | 9.0 | 4.4 | 3.2 | 2.2 | 1.45 | 1.25 | 1.25 | 1.3 | 1.55 | 1.55 |
| 27 | 9.8 | 5.3 | 8.9 | 4.3 | 3.2 | 2.1 | 1.45 | 1.25 | 1.25 | 1.3 | 1.6 | 1.7 |
| 28 | 8.95 | 5.0 | 8.2 | 4.15 | 3.2 | 2.0 | 1.45 | 1.25 | 1.3 | 1.3 | 1.7 | 1.7 |
| 29 | 7.5 | ....... | 15.5 | 4.05 | 3.2 | 2.0 | 1.45 | 1.25 | 1.3 | 1.3 | 1.8 | 1.9 |
| 30 | 6.85 | ....... | 9.85 | 4.0 | 3.15 | 1.95 | 1.45 | 1.25 | 1.3 | 1.3 | 1.95 | 1.8 |
| 31 | 6.55 | ....... | 8.7 | ....... | 3.05 | ....... | 1.45 | 1.25 | ....... | 1.3 | ....... | 1.9 |

*Station rating table for Sacramento River near Red Bluff, Cal., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 4,450 | 3.10 | 10,380 | 5.40 | 18,700 | 9.60 | 37,180 |
| 1.10 | 4,690 | 3.20 | 10,710 | 5.60 | 19,500 | 9.80 | 38,140 |
| 1.20 | 4,930 | 3.30 | 11,040 | 5.80 | 20,300 | 10.00 | 39,100 |
| 1.30 | 5,170 | 3.40 | 11,370 | 6.00 | 21,100 | 10.50 | 41,600 |
| 1.40 | 5,410 | 3.50 | 11,700 | 6.20 | 21,940 | 11.00 | 44,200 |
| 1.50 | 5,650 | 3.60 | 12,040 | 6.40 | 22,780 | 11.50 | 46,900 |
| 1.60 | 5,920 | 3.70 | 12,380 | 6.60 | 23,620 | 12.00 | 49,700 |
| 1.70 | 6,190 | 3.80 | 12,720 | 6.80 | 24,460 | 12.50 | 52,600 |
| 1.80 | 6,460 | 3.90 | 13,060 | 7.00 | 25,300 | 13.00 | 55,600 |
| 1.90 | 6,730 | 4.00 | 13,400 | 7.20 | 26,180 | 13.50 | 58,600 |
| 2.00 | 7,000 | 4.10 | 13,760 | 7.40 | 27,060 | 14.00 | 61,700 |
| 2.10 | 7,300 | 4.20 | 14,120 | 7.60 | 27,940 | 14.50 | 64,900 |
| 2.20 | 7,600 | 4.30 | 14,480 | 7.80 | 28,820 | 15.00 | 68,200 |
| 2.30 | 7,900 | 4.40 | 14,840 | 8.00 | 29,700 | 16.00 | 75,100 |
| 2.40 | 8,200 | 4.50 | 15,200 | 8.20 | 30,620 | 17.00 | 82,200 |
| 2.50 | 8,500 | 4.60 | 15,580 | 8.40 | 31,540 | 18.00 | 89,700 |
| 2.60 | 8,810 | 4.70 | 15,960 | 8.60 | 32,460 | 19.00 | 97,600 |
| 2.70 | 9,120 | 4.80 | 16,340 | 8.80 | 33,380 | 20.00 | 105,900 |
| 2.80 | 9,430 | 4.90 | 16,720 | 9.00 | 34,300 | | |
| 2.90 | 9,740 | 5.00 | 17,100 | 9.20 | 35,260 | | |
| 3.00 | 10,050 | 5.20 | 17,900 | 9.40 | 36,220 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1905. It is fairly well defined.

*Estimated monthly discharge of Sacramento River near Red Bluff, Cal., for 1905.*

[Drainage area, 9,295 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 108,500 | 10,380 | 31,830 | 1,957,000 | 3.42 | 3.94 |
| February | 74,050 | 15,200 | 26,800 | 1,488,000 | 2.88 | 3.00 |
| March | 71,600 | 13,580 | 30,920 | 1,901,000 | 3.33 | 3.84 |
| April | 29,930 | 13,400 | 18,680 | 1,112,000 | 2.01 | 2.24 |
| May | 19,100 | 10,220 | 12,750 | 784,000 | 1.37 | 1.58 |
| June | 10,050 | 6,865 | 8,623 | 513,100 | .928 | 1.04 |
| July | 6,865 | 5,530 | 6,075 | 373,500 | .654 | .754 |
| August | 5,530 | 5,050 | 5,251 | 322,900 | .565 | .651 |
| September | 5,170 | 5,050 | 5,062 | 301,200 | .545 | .608 |
| October | 5,170 | 5,050 | 5,155 | 317,000 | .555 | .640 |
| November | 6,865 | 5,170 | 5,616 | 334,200 | .604 | .674 |
| December | 7,300 | 5,785 | 6,100 | 375,100 | .656 | .756 |
| The year | 108,500 | 5,050 | 13,570 | 9,779,000 | 1.46 | 19.72 |

## SACRAMENTO RIVER AT SACRAMENTO, CAL.

The following gage heights were observed at this station during 1905:

*Daily gage height, in feet, of Sacramento River at Sacramento, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | 18.5 | 20.9 | 19.7 | 21.8 | 19.6 | 17.4 | 11.4 |
| 2 | 18.0 | 21.6 | 19.7 | 21.8 | 19.8 | 17.3 | 11.2 |
| 3 | 17.7 | 21.8 | 19.6 | 21.7 | 19.6 | 17.2 | 11.0 |
| 4 | 18.1 | 21.8 | 19.5 | 21.7 | 19.6 | 17.0 | 10.9 |
| 5 | 18.4 | 21.9 | 19.5 | 21.6 | 19.0 | 16.9 | 10.8 |
| 6 | 18.4 | 22.0 | 19.4 | 21.5 | 18.9 | 16.4 | 10.7 |
| 7 | 18.2 | 21.9 | 19.3 | 21.5 | 19.0 | 16.3 | 10.6 |
| 8 | 18.1 | 21.9 | 19.0 | 21.5 | 19.0 | 16.2 | 10.5 |
| 9 | 18.0 | 21.8 | 18.8 | 21.6 | 19.0 | 16.1 | 10.4 |
| 10 | 17.8 | 21.8 | 18.7 | 21.6 | 19.3 | 16.0 | 10.3 |
| 11 | 17.5 | 21.6 | 18.2 | 21.2 | 18.9 | 16.0 | 10.0 |
| 12 | 17.1 | 21.4 | 18.1 | 21.0 | 18.8 | 16.0 | 9.9 |
| 13 | 16.7 | 21.2 | 18.0 | 20.9 | 18.5 | 15.9 | 9.8 |
| 14 | 16.7 | 20.9 | 18.9 | 20.8 | 18.5 | 15.8 | 9.7 |
| 15 | 17.4 | 20.8 | 18.9 | 20.7 | 18.6 | 15.4 | 9.7 |
| 16 | 18.0 | 20.5 | 19.0 | 20.6 | 18.8 | 15.1 | 9.6 |
| 17 | 18.2 | 20.4 | 19.2 | 20.6 | 19.3 | 15.0 | 9.5 |
| 18 | 18.5 | 20.4 | 19.4 | 20.2 | 18.9 | 14.7 | 9.4 |
| 19 | 18.8 | 20.4 | 20.1 | 20.4 | 18.9 | 14.5 | 9.3 |
| 20 | 19.0 | 20.4 | 21.0 | 20.3 | 18.9 | 14.0 | 9.2 |
| 21 | 19.0 | 20.4 | 20.8 | 20.2 | 18.8 | 13.8 | 9.1 |
| 22 | 20.0 | 20.2 | 21.1 | 20.0 | 18.8 | 13.6 | 9.0 |
| 23 | 20.5 | 20.1 | 21.0 | 19.9 | 18.6 | 13.3 | 8.9 |
| 24 | 20.2 | 20.0 | 21.2 | 19.8 | 18.5 | 13.0 | 8.8 |
| 25 | 20.4 | 20.0 | 21.2 | 19.7 | 18.0 | 12.7 | 8.7 |
| 26 | 20.5 | 20.0 | 21.3 | 19.8 | 17.9 | 12.4 | 8.6 |
| 27 | 20.7 | 20.0 | 21.7 | 20.1 | 18.0 | 12.0 | 8.4 |
| 28 | 20.8 | 19.9 | 21.6 | 20.0 | 17.9 | 11.9 | 8.2 |
| 29 | 20.8 | ........ | 21.8 | 19.9 | 17.8 | 11.8 | 8.2 |
| 30 | 20.9 | ........ | 21.8 | 19.8 | 17.7 | 11.6 | ........ |
| 31 | 20.9 | ........ | 21.9 | ........ | 17.5 | ........ | ........ |

## MISCELLANEOUS MEASUREMENTS IN SACRAMENTO RIVER DRAINAGE BASIN.

*Sacramento River at Baird Station, on Southern Pacific Railway, Gregory post-office, Cal.*—A measurement of this stream was made August 28, 1905, from wagon bridge by W. B. Clapp.

Width, 116 feet; area, 308 square feet; mean velocity, 1.14 feet per second; discharge, 352 second-feet.

*Clear Creek near Stella post-office, Cal.*—A measurement was made of this stream August 26, 1905, 500 feet above mouth of Brandy Creek by W. B. Clapp.

Width, 28 feet; area, 31 square feet; mean velocity, 1.26 feet per second; discharge, 39 second-feet.

*North Fork Cottonwood Creek near Gas Point, Cal.*—A measurement of this stream was made August 28, 1905, 40 feet below the highway bridge above the junction of the North and Middle forks by C. H. Lee. Several diversions are made above the point of measurement; their total discharge is reported to be about 8 second-feet.

Width, 15.5 feet; area, 9.0 square feet; mean velocity, 0.66 foot per second; discharge, 5.9 second-feet.

*Middle Fork Cottonwood Creek near Gas Point, Cal.*—A measurement of this stream was made August 28, 1905, 300 feet above its junction with the North Fork by C. H. Lee. Three small diversions are made above the point of measurement.

Width, 35 feet; area, 11.3 square feet; mean velocity, 0.81 foot per second; discharge, 9.1 second-feet.

*Pit River near Copper City, Cal.*—This stream is the largest tributary of the Sacramento River, joining it about 11 miles north of Redding, Cal. It has a well-sustained summer flow. A measurement of this stream was made August 25, 1905, by C. H. Lee from the downstream side of the Delamar Mining Company's toll bridge above the mouth of Squaw Creek.

Width, 135 feet; area, 465 square feet; mean velocity, 6.68 feet per second; discharge, 3,107 second-feet.

*Squaw Creek near Copper City, Cal.*—A measurement of this stream was made 500 feet below bridge near Copper City by C. H. Lee on August 26, 1905.

Width, 39 feet; area, 95 square feet; mean velocity, 0.21 foot per second; discharge, 20 second-feet.

*Cow Creek (above Clover Creek) at Millville, Cal.*—A measurement of this stream was made August 26, 1905, at the highway bridge south of Millville by C. H. Lee.

Width, 39.2 feet; area, 35 square feet; mean velocity, 1.75 feet per second; discharge, 61 second-feet.

*Clover Creek at Millville, Cal.*—A measurement of this stream was made August 26, 1905, about 500 feet below the highway bridge above its junction with Cow Creek by C. H. Lee.

Width, 15 feet; area, 7.8 square feet; mean velocity, 0.40 foot per second; discharge, 3.1 second-feet.

*Clover Creek ditch.*—A measurement of this ditch was made on August 27, 1905, in flume at its heading, 3 miles above Millville by C. H. Lee.

Width, 2.15 feet; area, 1.8 square feet; mean velocity, 1.33 feet per second; discharge, 2.4 second-feet. This water is diverted from Clover Creek.

*Little Cow Creek near Palocedro, Cal.*—A measurement of this stream was made on August 27, 1905, 800 feet downstream from the highway bridge east of Palocedro by C. H. Lee. There are several small diversions from this stream above this point.

Width, 11.2 feet; area, 9.0 square feet; mean velocity, 0.50 foot per second; discharge, 4.5 second-feet.

*Cow Creek near Palocedro, Cal.*—A measurement of this stream was made August 27, 1905, 150 feet below its junction with Little Cow Creek by C. H. Lee.

Width, 41.5 feet; area, 58 square feet; mean velocity, 1.05 feet per second; discharge, 61 second-feet.

*Battle Creek near Balls Ferry, Cal.*—This stream is an important tributary of the Sacramento River. A measurement was made August 29, 1905, at a point about 2 miles above the wagon bridge on main road from Red Bluff to Balls Ferry by C. H. Lee.

Width, 88 feet; area, 171 square feet; mean velocity, 1.92 feet per second; discharge, 329 second-feet.

*Mill ditch near Balls Ferry, Cal.*—This ditch heads in Battle Creek 1½ miles above the wagon bridge on the main road from Red Bluff to Balls Ferry. A measurement was made August 29, 1905, 1½ miles below head of ditch, by C. H. Lee.

Width, 22 feet; area, 19.3 square feet; mean velocity, 1.33 feet per second; discharge, 26 second-feet.

*Antelope Creek near Red Bluff, Cal.*—A measurement of this stream was made August 31, 1905, 600 feet above the Antelope Creek and Red Bluff Water Company's dam, about 8 miles east of Red Bluff, by C. H. Lee.

Width, 36 feet; area, 83 square feet; mean velocity, 0.54 foot per second; discharge, 45 second-feet.

*Mill Creek near Tehama, Cal.*—A measurement of this stream was made September 1, 1905, 300 feet above the head-gate of the Los Molinas ditch and about 6 miles east of Tehama, by C. H. Lee.

Width, 40.2 feet; area, 91 square feet; mean velocity, 1.34 feet per second; discharge, 122 second-feet.

*Millrace canal near Tehama, Cal.*—This canal diverts water from Mill Creek about 1½ miles above its junction with Sacramento River. A measurement was made in flume at head of canal September 1, 1905, by C. H. Lee.

Width, 11.8 feet; area, 40 square feet; mean velocity, 2.25 feet per second; discharge, 90 second-feet.

*Deer Creek near Vina, Cal.*—A measurement of this stream was made September 1, 1905, from the downstream side of the bridge at upper main road crossing, about 4 miles from Vina, by C. H. Lee. Two or three small ditches divert water from creek above this point of measurement.

Width, 57.7 feet; area, 77 square feet; mean velocity, 1.08 feet per second; discharge, 83 second-feet.

*Valley Counties Power Company's canal near Centerville, Cal.*—This canal diverts water from Butte Creek. A measurement was made May 19 in flume at town of Centerville.

Width, 6 feet; area, 13.2 square feet; mean velocity, 1.74 feet per second; discharge, 23 second-feet.

## PIT RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Pit River has its source in the Warner Mountains in the extreme northeast part of California. It flows in a southwesterly direction, discharging its waters into Sacramento River a few miles above Redding, Cal. It has numerous tributaries, the larger of which have their source in large springs, which discharge from crevices in the lava formation. About 50 per cent of the area of this drainage basin is barren of timber and composed, principally, of lava with a light soil covering, being used extensively for pasturage and the raising of stock. There are numerous small valleys with light grades, which hold the water throughout the summer months principally in the state of swamps. These areas are used, mainly, as meadow land and for the raising of stock feed. Pit River does not discharge in any great volume until it reaches a point near Fall River Mills, which lies about midway between the point where the Pit River enters the Sacramento and its source. Fall River, which is the principal tributary of the Pit from the north, receives its water supply from large perennial springs which discharge 1,500 second-feet. Hat Creek and Burney Creek are also large tributaries from the south and drain the northern slope of Lassen Peak. Their principal sources are also from large perennial springs in the lava formation.

West Valley Creek is a tributary of South Fork of Pit River. Ash Creek flows into Clear Creek, through which it enters Pit River from the south. There is considerable timber scattered throughout this drainage basin, the principal growth lying in the southern portion of the basin and also in that section lying north of Pit River and between Fall River and the upper Sacramento. There are numerous reservoir sites on the upper reaches of this stream, all of which have been or are being surveyed. Several gaging stations are maintained on Pit River and tributaries at points where surveys have been made for the construction of storage reservoirs. The rainfall throughout this basin is very unevenly distributed, ranging from 10 inches in the eastern portion to 50 to 75 inches in the western and northwestern portion. About 50 per cent of the precipitation falls in the form of snow, but does not remain any length of time except on the higher elevation of Mount Shasta and Lassen Peak.

McCloud River drains the southeastern slope of Mount Shasta. Its drainage area is comparatively small, covering 676 square miles. It is long and narrow, extending from north to south. There are few tributaries. Its main water supply comes from Mount Shasta, on which the snow remains during the entire year. It is also fed by numerous large springs scattered throughout the drainage basin. The precipitation is very heavy and is principally in the form of rain, except on the higher elevations of Mount Shasta. The discharge of this stream seldom falls below 1,200 second-feet. It discharges into the Pit River a few miles above the junction of the Pit with the Sacramento. The entire basin is well timbered.

### PIT RIVER NEAR CANBY, CAL.

This station was established December 26, 1903, by H. E. Green and J. S. Evans. It is located at the wagon bridge, 3½ miles southwest of Canby, Cal.

The channel is straight for 150 feet above and 200 feet below the station. The current is moderate at all stages. The banks are high and are subject to overflow. The channel is rocky and is not subject to much change.

Discharge measurements are made from the bridge. The initial point for soundings is a nail in the railing post at the end of the bridge on the left bank.

The gage is a vertical plank securely fastened to the first bridge pier from the left bank of the stream. During 1905 the gage was read twice each day by Ernest M. Hess. The bench mark is a painted point on a large bowlder at the bend of the wagon road near the south end of the bridge. Elevation, 24.90 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Pit River near Canby, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 5 | J. Y. Toler | 99 | 187 | 2.55 | 4.20 | 476 |
| January 9 | do | 87 | 127 | 1.70 | 3.70 | 216 |
| January 20 | do | 99 | 186 | 2.53 | 4.18 | 470 |
| January 26 | do | 117 | 228 | 2.96 | 4.50 | 675 |
| February 7 | do | 116 | 220 | 2.91 | 4.40 | 641 |
| February 13 | do | 87 | 131 | 1.91 | 3.70 | 250 |
| February 22 | do | 119 | 235 | 3.03 | 4.60 | 712 |
| February 27 | do | 93 | 147 | 2.11 | 3.90 | 309 |
| March 7 | do | 87 | 128 | 1.86 | 3.65 | 238 |
| March 9 | do | 87 | 127 | 1.83 | 3.65 | 233 |
| March 14 | do | 87 | 135 | 1.80 | 3.70 | 243 |
| March 22 | do | 109 | 227 | 2.90 | 4.60 | 659 |
| March 26 | do | 109 | 230 | 2.93 | 4.65 | 674 |
| April 4 | do | 138 | 292 | 3.33 | 5.00 | 971 |
| April 5 | do | 138 | 289 | 3.30 | 5.00 | 955 |
| April 10 | do | 114 | 206 | 2.81 | 4.40 | 579 |
| April 16 | do | 93 | 146 | 2.27 | 4.00 | 331 |
| April 19 | do | 93 | 136 | 2.07 | 3.90 | 282 |
| May 1 | do | 63 | 83 | 1.08 | 3.30 | 90 |
| May 2 | do | 63 | 83 | 1.10 | 3.30 | 91 |
| May 5 | do | 61 | 54 | .57 | 2.90 | 31 |
| May 16 | do | 90 | 120 | 1.85 | 3.70 | 222 |
| May 20 | do | 90 | 115 | 1.84 | 3.70 | 212 |
| June 9 | do | 87 | 123 | 1.64 | 3.60 | 201 |
| July 17 | do | 52 | 40 | .60 | 2.90 | 24 |
| July 22 | do | 50 | 37 | .62 | 2.85 | 23 |
| August 8 | do | 60 | 39 | .37 | 2.80 | 14.5 |
| August 10 | do | 60 | 37 | .38 | 2.75 | 14.1 |
| August 21 | do | 9 | 2.9 | 1.27 | 2.50 | 3.7 |
| August 28 | do | 7 | 1.8 | 1.17 | 2.45 | 2.1 |
| August 31 | do | 7 | 2.0 | 1.15 | 2.45 | 2.3 |
| September 9 | do | 8 | 2.6 | 1.19 | 2.50 | 3.1 |
| September 19 | do | 9 | 3.4 | 1.68 | 2.60 | 5.7 |
| October 6 | do | 35 | 21 | 1.00 | 2.80 | 21 |
| October 19 | do | 55 | 57 | .91 | 3.10 | 52 |
| October 25 | do | 58 | 58 | .86 | 3.20 | 50 |
| October 28 | do | 58 | 61 | .90 | 3.20 | 55 |
| November 7 | do | 60 | 67 | 1.19 | 3.30 | 80 |
| November 11 | do | 60 | 70 | 1.19 | 3.30 | 83 |

*Daily gage height, in feet, of Pit River near Canby, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.55 | 4.6 | 3.8 | 5.5 | 3.4 | 3.6 | 3.3 | 2.9 | 2.5 | 2.8 | 3.2 | 3.5 |
| 2 | 4.4 | 5.05 | 3.8 | 5.6 | 3.4 | 3.7 | 3.25 | 2.9 | 2.5 | 2.8 | 3.25 | 3.5 |
| 3 | 4.1 | 5.25 | 3.75 | 5.5 | 3.3 | 3.7 | 3.25 | 2.9 | 2.5 | 2.8 | 3.25 | 3.5 |
| 4 | 4.0 | 5.65 | 3.7 | 5.4 | 3.0 | 3.7 | 3.25 | 2.9 | 2.5 | 2.8 | 3.3 | 3.5 |
| 5 | 3.9 | 4.85 | 3.7 | 5.5 | 3.0 | 3.7 | 3.25 | 2.9 | 2.5 | 2.8 | 3.3 | 3.5 |
| 6 | 3.8 | 4.65 | 3.7 | 4.8 | 3.0 | 3.5 | 3.25 | 2.5 | 2.5 | 2.8 | 3.3 | 3.5 |
| 7 | 3.8 | 4.25 | 3.65 | 4.8 | 3.6 | 3.6 | 3.2 | 2.5 | 2.5 | 2.8 | 3.3 | 3.5 |
| 8 | 3.8 | 4.1 | 3.65 | 4.7 | 3.6 | 3.7 | 3.2 | 2.5 | 2.5 | 2.8 | 3.3 | 3.5 |
| 9 | 3.7 | 4.05 | 3.65 | 4.5 | 3.3 | 3.65 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.5 |
| 10 | 3.6 | 4.0 | 3.65 | 4.3 | 3.15 | 3.65 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.4 |
| 11 | 3.55 | 3.9 | 3.65 | 4.2 | 3.2 | 3.6 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.4 |
| 12 | 3.45 | 3.7 | 3.7 | 4.1 | 3.2 | 3.6 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.35 |
| 13 | 3.5 | 3.7 | 3.7 | 4.1 | 3.2 | 3.6 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.3 |
| 14 | 3.7 | 3.75 | 3.7 | 4.0 | 3.6 | 3.5 | 3.2 | 2.5 | 2.5 | 3.05 | 3.3 | 3.3 |
| 15 | 3.95 | 3.7 | 3.7 | 4.0 | 3.8 | 3.5 | 3.2 | 2.5 | 2.5 | 3.1 | 3.3 | 3.3 |
| 16 | 4.25 | 3.65 | 3.8 | 4.0 | 3.8 | 3.4 | 3.2 | 2.5 | 2.5 | 3.1 | 3.25 | 3.3 |
| 17 | 4.3 | 3.75 | 4.1 | 4.0 | 3.8 | 3.4 | 3.2 | 2.5 | 2.5 | 3.15 | 3.25 | 3.3 |
| 18 | 4.3 | 3.8 | 4.35 | 4.0 | 3.8 | 3.4 | 3.2 | 2.5 | 2.5 | 3.15 | 3.25 | 3.3 |
| 19 | 4.3 | 4.2 | 4.4 | 4.0 | 3.8 | 3.4 | 3.2 | 2.5 | 2.6 | 3.2 | 3.25 | 3.35 |
| 20 | 4.2 | 4.95 | 4.5 | 3.95 | 3.8 | 3.4 | 3.2 | 2.4 | 2.6 | 3.2 | 3.3 | 3.4 |
| 21 | 4.1 | 4.8 | 4.95 | 3.85 | 3.75 | 3.4 | 3.2 | 2.4 | 2.6 | 3.2 | 3.3 | 3.4 |
| 22 | 4.35 | 4.6 | 4.8 | 3.8 | 3.7 | 3.4 | 3.2 | 2.4 | 2.6 | 3.2 | 3.3 | 3.4 |
| 23 | 4.5 | 4.3 | 4.45 | 3.3 | 3.65 | 3.4 | 3.1 | 2.4 | 2.6 | 3.2 | 3.35 | 3.4 |
| 24 | 5.0 | 4.2 | 4.5 | 3.3 | 3.8 | 3.4 | 3.1 | 2.4 | 2.6 | 3.2 | 3.35 | 3.4 |
| 25 | 5.35 | 4.1 | 4.6 | 3.3 | 3.7 | 3.4 | 3.1 | 2.4 | 2.6 | 3.2 | 3.4 | 3.4 |
| 26 | 4.6 | 4.0 | 4.7 | 3.3 | 3.6 | 3.4 | 3.1 | 2.4 | 2.6 | 3.2 | 3.4 | 3.4 |
| 27 | 4.2 | 4.0 | 4.8 | 3.4 | 3.5 | 3.3 | 3.1 | 2.5 | 2.7 | 3.2 | 3.4 | 3.4 |
| 28 | 4.05 | 3.9 | 4.85 | 3.4 | 3.5 | 3.3 | 3.1 | 2.5 | 2.8 | 3.2 | 3.4 | 3.4 |
| 29 | 4.0 | ....... | 4.85 | 3.5 | 3.5 | 3.3 | 3.1 | 2.5 | 2.8 | 3.2 | 3.45 | 3.4 |
| 30 | 4.0 | ....... | 4.8 | 3.4 | 3.6 | 3.3 | 3.1 | 2.5 | 2.8 | 3.2 | 3.5 | 3.4 |
| 31 | 4.15 | ....... | 5.0 | ....... | 3.6 | ....... | 3.1 | 2.5 | ....... | 3.2 | ....... | 3.4 |

*Station rating table for Pit River near Canby, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.40 | 1.5 | 3.30 | 87 | 4.20 | 475 | 5.10 | 1,028 |
| 2.50 | 3.5 | 3.40 | 115 | 4.30 | 533 | 5.20 | 1,091 |
| 2.60 | 6 | 3.50 | 148 | 4.40 | 593 | 5.30 | 1,154 |
| 2.70 | 10 | 3.60 | 186 | 4.50 | 655 | 5.40 | 1,217 |
| 2.80 | 16 | 3.70 | 226 | 4.60 | 717 | 5.50 | 1,280 |
| 2.90 | 24 | 3.80 | 269 | 4.70 | 779 | 5.60 | 1,343 |
| 3.00 | 34 | 3.90 | 316 | 4.80 | 841 | | |
| 3.10 | 47 | 4.00 | 366 | 4.90 | 903 | | |
| 3.20 | 64 | 4.10 | 419 | 5.00 | 965 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on thirty-nine discharge measurements made during 1905. It is well defined between gage heights 2.4 feet and 5 feet.

*Estimated monthly discharge of Pit River near Canby, Cal., for 1905.*

[Drainage area, 1,500 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,186 | 132 | 443 | 27,240 | 0.295 | 0.340 |
| February | 1,374 | 206 | 533 | 29,600 | .355 | .370 |
| March | 965 | 206 | 479 | 29,450 | .319 | .368 |
| April | 1,343 | 87 | 510 | 30,350 | .340 | .379 |
| May | 269 | 34 | 165 | 10,140 | .110 | .127 |
| June | 226 | 87 | 151 | 8,985 | .101 | .113 |
| July | 87 | 47 | 61.7 | 3,794 | .041 | .047 |
| August | 24 | 1.5 | 6.4 | 394 | .0043 | .0050 |
| September | 16 | 3.5 | 5.6 | 333 | .0037 | .0041 |
| October | 64 | 16 | 45.4 | 2,792 | .030 | .035 |
| November | 148 | 64 | 92.2 | 5,486 | .061 | .068 |
| December | 148 | 87 | 118 | 7,256 | .079 | .091 |
| The year | 1,374 | 1.5 | 218 | 155,800 | .145 | 1.95 |

## PIT RIVER NEAR BIEBER, CAL.

This station was established January 22, 1904, by J. S. Evans and William Busch. It is located 12 miles below Bieber, Cal., near Muck Valley.

The channel is straight for 200 feet above and 300 feet below the station. The current is very sluggish at low-water stage. The banks are high and not subject to overflow. The channel is very rocky and rough, but is not subject to change.

Discharge measurements are made from a cable and car. The initial point for soundings is the foot of the platform at end of the cable on the right bank of the stream.

The gage is a heavy wooden rod fastened to a large bowlder on the right bank of the stream. During 1905 the gage was read once each day by F. H. Holabird. The bench mark is on a large bowlder on the right bank 50 feet east of the pine tree to which the cable is fastened; elevation 12.00 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Pit River near Bieber, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 8 | J. Y. Toler | 104 | 343 | 0.99 | 3.70 | 340 |
| January 22 | do | 210 | 729 | 1.96 | 5.25 | 1,430 |
| January 23 | do | 218 | 915 | 2.46 | 6.00 | 2,254 |
| Do | do | 217 | 889 | 2.50 | 5.94 | 2,220 |
| February 9 | do | 204 | 630 | 1.68 | 4.80 | 1,060 |
| February 24 | do | 208 | 673 | 1.93 | 5.08 | 1,296 |
| March 11 | do | 144 | 389 | .97 | 3.70 | 378 |
| March 24 | do | 212 | 743 | 2.22 | 5.40 | 1,650 |
| March 23 | do | 213 | 767 | 2.11 | 5.51 | 1,620 |
| April 7 | do | 210 | 739 | 2.02 | 5.30 | 1,492 |
| April 6 | do | 212 | 757 | 2.18 | 5.40 | 1,648 |
| April 17 | do | 199 | 504 | 1.32 | 4.30 | 665 |
| May 3 | do | 126 | 232 | .61 | 2.88 | 141 |
| May 18 | do | 134 | 309 | .79 | 3.50 | 244 |
| June 12 | do | 126 | 215 | .51 | 2.80 | 110 |
| July 7 | do | 75 | 143 | .24 | 2.30 | 34 |
| July 19 | do | 79 | 144 | .29 | 2.40 | 42 |
| August 9 | do | 58 | 105 | .22 | 1.85 | 23 |
| August 18 | do | 34 | 18.8 | 1.02 | 1.80 | 19.1 |
| August 29 | do | 30 | 12.6 | .78 | 1.70 | 9.9 |
| September 10 | do | 6 | 2.4 | .46 | 1.40 | 1.1 |
| September 20 | do | 7 | 2.0 | .60 | 1.40 | 1.2 |
| October 7 | do | 6 | 2.8 | .61 | 1.50 | 1.7 |
| October 17 | do | 31 | 12.7 | .83 | 1.70 | 10.5 |
| October 26 | do | 45 | 22.5 | 1.80 | 2.20 | 41 |
| November 8 | do | 80 | 168 | .42 | 2.60 | 71 |

*Daily gage height, in feet, of Pit River near Bieber, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.8 | 5.4 | 4.6 | 6.2 | 3.0 | 3.2 | 2.5 | 2.1 | 1.5 | [a]1.5 | [a]2.3 | [a]2.4 |
| 2 | 5.0 | 5.5 | 4.5 | 6.3 | 3.0 | 3.2 | 2.45 | 2.1 | 1.5 | [a]1.5 | [a]2.4 | [a]2.4 |
| 3 | 4.9 | 5.3 | 4.3 | 6.15 | 2.9 | 3.1 | 2.4 | 1.9 | 1.5 | [a]1.5 | [a]2.4 | [a]2.4 |
| 4 | 4.5 | 5.0 | 4.0 | 5.9 | 2.9 | 3.1 | 2.4 | 1.8 | 1.4 | [a]1.5 | [a]2.5 | [a]2.4 |
| 5 | 4.2 | 4.8 | 4.0 | 5.7 | 2.9 | 3.1 | 2.4 | 1.8 | 1.4 | [a]1.5 | [a]2.5 | [a]2.4 |
| 6 | 3.9 | 4.6 | 4.0 | 5.4 | 3.0 | 3.0 | 2.3 | 1.8 | 1.4 | [a]1.5 | [a]2.5 | [a]2.4 |
| 7 | 3.7 | 6.0 | 3.9 | 5.2 | 3.0 | 3.0 | 2.3 | 1.75 | 1.4 | 1.5 | [a]2.5 | [a]2.4 |
| 8 | 3.7 | 5.5 | 3.9 | 5.1 | 3.0 | 2.9 | 2.3 | 1.75 | 1.35 | [a]1.5 | 2.6 | [a]2.4 |
| 9 | 3.5 | 4.8 | 3.8 | 5.0 | 2.9 | 2.9 | 2.4 | 1.85 | 1.35 | [a]1.5 | [a]2.6 | [a]2.4 |
| 10 | 3.4 | 4.6 | 3.7 | 4.9 | 2.9 | 2.8 | 2.35 | 1.8 | 1.4 | [a]1.5 | [a]2.6 | [a]2.4 |
| 11 | 3.4 | 4.3 | 3.7 | 4.7 | 2.8 | 2.8 | 2.45 | 1.8 | 1.4 | [a]1.5 | [a]2.6 | [a]2.4 |
| 12 | 3.3 | 3.9 | 3.7 | 4.6 | 2.8 | 2.8 | 2.45 | 1.5 | 1.4 | [a]1.6 | [a]2.6 | [a]2.3 |
| 13 | 3.4 | 3.7 | 3.7 | 4.4 | 2.8 | 2.8 | 2.4 | 1.5 | 1.4 | [a]1.6 | [a]2.6 | [a]2.3 |
| 14 | 3.4 | 3.7 | 3.8 | 4.3 | 2.8 | 2.7 | 2.4 | 1.5 | [a]1.4 | [a]1.6 | [a]2.6 | [a]2.3 |
| 15 | 3.6 | 3.9 | 3.8 | 4.2 | 2.8 | 2.7 | 2.7 | 1.5 | [a]1.4 | [a]1.6 | [a]2.7 | [a]2.3 |
| 16 | 3.9 | 4.0 | 4.0 | 4.3 | 3.0 | 2.7 | 2.7 | 1.7 | [a]1.4 | [a]1.6 | [a]2.7 | [a]2.3 |
| 17 | 4.95 | 4.1 | 4.0 | 4.3 | 3.4 | 2.7 | 2.7 | 1.7 | [a]1.4 | 1.7 | [a]2.7 | [a]2.3 |
| 18 | 5.1 | 4.3 | 5.0 | 4.3 | 3.5 | 2.7 | 2.3 | 1.8 | [a]1.4 | 2.0 | [a]2.7 | [a]2.3 |
| 19 | 5.0 | 4.6 | 5.4 | 4.2 | 3.5 | 2.5 | 2.4 | 1.8 | [a]1.4 | 2.0 | [a]2.7 | [a]2.3 |
| 20 | 5.0 | 4.8 | 5.5 | 4.0 | 3.4 | 2.5 | 2.4 | 1.7 | [a]1.4 | 2.0 | [a]2.7 | [a]2.3 |
| 21 | 5.0 | 5.0 | 5.5 | 4.0 | 3.4 | 2.5 | 2.3 | 1.7 | [a]1.4 | 2.0 | [a]2.7 | 3.3 |
| 22 | 5.25 | 5.8 | 5.8 | 3.9 | 3.2 | 2.4 | 2.2 | 1.5 | [a]1.4 | 2.0 | [a]2.7 | 3.3 |
| 23 | 5.95 | 5.2 | 5.55 | 3.9 | 3.2 | 2.4 | 2.2 | 1.5 | [a]1.4 | 2.0 | [a]2.6 | 2.2 |
| 24 | 6.5 | 5.05 | 5.45 | 3.7 | 3.2 | 2.4 | 2.6 | 1.5 | [a]1.4 | [a]2.0 | [a]2.6 | 2.2 |
| 25 | 6.0 | 5.0 | 5.4 | 3.6 | 3.1 | 2.3 | 2.4 | 1.5 | [a]1.4 | [a]2.0 | [a]2.6 | 2.2 |
| 26 | 5.8 | 5.0 | 5.7 | 3.4 | 3.1 | 2.3 | 2.1 | 1.5 | [a]1.4 | 2.2 | [a]2.6 | 2.2 |
| 27 | 5.5 | 4.8 | 5.9 | 3.1 | 3.0 | 2.3 | 2.1 | 1.7 | [a]1.4 | [a]2.2 | [a]2.6 | 2.2 |
| 28 | 5.0 | 4.8 | 5.8 | 3.1 | 3.1 | 2.7 | 2.1 | 1.7 | 1.5 | [a]2.2 | [a]2.6 | 2.2 |
| 29 | 4.8 | ....... | 5.8 | 3.1 | 3.2 | 2.7 | 2.2 | 1.7 | 1.5 | [a]2.2 | [a]2.6 | 2.2 |
| 30 | 5.1 | ....... | 5.8 | 3.0 | 3.3 | 2.7 | 2.2 | 1.5 | [a]1.5 | [a]2.3 | [a]2.5 | 2.2 |
| 31 | 5.4 | ....... | 6.0 | ....... | 3.3 | ....... | 2.25 | 1.5 | ....... | [a]2.3 | ....... | 2.2 |

[a] Estimated.

NOTE.—River frozen over December 23–31.

*Station rating table for Pit River near Bieber, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 0.5 | 2.50 | 64 | 3.70 | 349 | 4.90 | 1,130 |
| 1.40 | 1.0 | 2.60 | 77 | 3.80 | 396 | 5.00 | 1,215 |
| 1.50 | 2.2 | 2.70 | 92 | 3.90 | 448 | 5.20 | 1,400 |
| 1.60 | 5.8 | 2.80 | 109 | 4.00 | 505 | 5.40 | 1,595 |
| 1.70 | 9.6 | 2.90 | 127 | 4.10 | 565 | 5.60 | 1,810 |
| 1.80 | 13.6 | 3.00 | 147 | 4.20 | 630 | 5.80 | 2,035 |
| 1.90 | 18 | 3.10 | 168 | 4.30 | 695 | 6.00 | 2,270 |
| 2.00 | 23 | 3.20 | 190 | 4.40 | 760 | 6.20 | 2,525 |
| 2.10 | 29 | 3.30 | 213 | 4.50 | 830 | 6.40 | 2,810 |
| 2.20 | 36 | 3.40 | 239 | 4.60 | 900 | | |
| 2.30 | 44 | 3.50 | 270 | 4.70 | 975 | | |
| 2.40 | 53 | 3.60 | 307 | 4.80 | 1,050 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 26 discharge measurements made during 1905. It is well defined between gage heights 3.5 feet and 6 feet. Below 3.5 feet the table is not so well defined.

*Estimated monthly discharge of Pit River near Bieber, Cal., for 1905.*

[Drainage area, 2,948 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,960 | 213 | 1,036 | 63,700 | 0.351 | 0.405 |
| February | 2,270 | 349 | 1,083 | 60,150 | .367 | .382 |
| March | 2,270 | 349 | 1,101 | 67,700 | .373 | .430 |
| April | 2,665 | 147 | 950 | 56,530 | .322 | .359 |
| May | 270 | 109 | 166 | 10,210 | .056 | .065 |
| June | 190 | 44 | 103 | 6,129 | .035 | .039 |
| July | 92 | 29 | 51.8 | 3,185 | .018 | .021 |
| August | 29 | 2.2 | 9.73 | 598 | .0033 | .0038 |
| September | 2.2 | .8 | 1.23 | 73.2 | .00042 | .00047 |
| October | 44 | 2.2 | 15.4 | 947 | .0052 | .0060 |
| November | 92 | 44 | 76.1 | 4,528 | .026 | .029 |
| December 1-22 | 213 | 44 | 63.9 | 2,788 | .022 | .025 |
| The period | | | | 276,500 | | |

NOTE.—Discharge interpolated for missing gage heights in September, October, November, and December.

### SOUTH FORK OF PIT RIVER NEAR IVY, CAL.

This station was established January 11, 1904, by H. E. Green and J. S. Evans. It is located 3 miles west of Ivy post-office, at the outlet of Jess Valley.

The channel is straight for 200 feet above and 80 feet below the station. The current is sluggish at low-water stage. The right bank is low and subject to overflow in high water. The bed of the stream is composed of earth and is filled with vegetation at low-water stage.

Discharge measurements are made from a cable and car. The initial point for soundings is the foot of the post used for fastening the car on the left bank of the stream.

The gage is a vertical plank fastened to a tree on the left bank 50 feet above the station. It is read only at times discharge measurements are made, as it is impossible to get an observer on account of its isolated location. The bench mark is on a large bowlder 150 feet east of cabin on the right bank and below the station; elevation, 12.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of South Fork of Pit River near Ivy, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. feet.* | *Ft. per sec.* | *Feet.* | *Sec.-feet.* |
| January 1 | J. Y. Toler | 32 | 63 | 0.92 | 4.90 | 58 |
| January 13 | do | 28 | 37 | .62 | 3.80 | 23 |
| February 1 | do | 30 | 47 | 1.04 | 4.18 | 49 |
| February 17 | do | 28 | 42 | 1.00 | 4.00 | 42 |
| March 4 | do | 28 | 42 | 1.05 | 4.05 | 44 |
| March 17 | do | 31 | 63 | 1.46 | 4.72 | 93 |
| March 30 | do | 30 | 51 | 1.18 | 4.30 | 60 |
| April 13 | do | 33 | 61 | 1.41 | 4.60 | 86 |
| April 22 | do | 33 | 62 | 1.37 | 4.60 | 85 |
| May 12 | do | 66 | 104 | 1.52 | 5.33 | 158 |
| May 13 | do | 66 | 101 | 1.53 | 5.33 | 155 |
| May 25 | do | 85 | 112 | 1.41 | 5.40 | 158 |
| May 26 | do | 98 | 118 | 1.40 | 5.44 | 165 |
| June 5 | do | 107 | 145 | 1.34 | 5.68 | 195 |
| June 6 | do | 97 | 126 | 1.31 | 5.50 | 165 |
| June 17 | do | 39 | 80 | 1.32 | 5.05 | 106 |
| June 19 | do | 38 | 78 | 1.28 | 5.00 | 100 |
| July 1 | do | 24 | 22 | 1.86 | 4.15 | 41 |
| July 13 | do | 23 | 19.5 | 1.79 | 4.05 | 35 |
| July 14 | do | 23 | 18.3 | 1.75 | 4.00 | 32 |
| July 26 | do | 15 | 20 | 1.60 | 4.00 | 32 |
| July 27 | do | 15 | 20 | 1.60 | 4.00 | 32 |
| August 15 | do | 16 | 19.5 | 1.44 | 4.10 | 28 |
| August 16 | do | 16 | 19.8 | 1.41 | 4.10 | 28 |
| August 24 | do | 16 | 17.2 | 1.16 | 3.70 | 19.9 |
| September 5 | do | 6 | 8.6 | 1.42 | 3.20 | 12.2 |
| September 14 | do | 14 | 8.6 | 1.95 | 3.30 | 16.8 |
| October 3 | do | 15 | 7.2 | 1.97 | 3.20 | 14.2 |
| October 12 | do | 15 | 7.2 | 1.97 | 3.20 | 14.2 |
| October 13 | do | 15 | 7.2 | 2.00 | 3.20 | 14.4 |
| October 21 | do | 16 | 6.8 | 2.03 | 3.20 | 13.8 |
| November 1 | do | 15 | 7.2 | 2.03 | 3.20 | 14.6 |
| November 2 | do | 16 | 8.0 | 2.09 | 3.20 | 16.7 |
| November 14 | do | 16 | 8.4 | 2.13 | 3.20 | 17.9 |
| November 15 | do | 16 | 7.6 | 2.12 | 3.20 | 16.1 |

## WEST VALLEY CREEK NEAR LIKELY, CAL.

This station was established January 7, 1904, by H. E. Green and J. S. Evans. It is located 7 miles east of Likely, Cal., at the outlet of West Valley.

The channel is straight for 200 feet above and 100 feet below the station. The banks are high and not subject to overflow. The bed of the stream is rocky and not subject to change. The current is swift.

Discharge measurements are made from a cable and car, or by wading at low-water stage. The initial point for soundings is a juniper stump on the left bank, which is used for a tieing post for the car. After July 1, 1905, gagings were made at the ranch house near the upper rod. These gagings give a much less discharge than at the regular station. The gage is a vertical plank nailed to a juniper tree on the right bank of the creek. As no one could be obtained to read the station gage, a gage was placed 2 miles above the station near the ranch house, where an observer could be obtained. The gage as read at this point is not considered satisfactory for use in constructing a discharge curve for the gaging station, but only gives a general idea of the fluctuations in the flow of the stream.

Numerous springs and swamps appear in the valley between the gaging station and the ranch house, giving a greater discharge at the gaging station than at this point. During 1905 the gage was read by Jasper L. Fountain. The bench mark is a point marked with paint on a large bowlder 30 feet from the creek on the left bank; elevation, 10.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of West Valley Creek near Likely, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 12 | J. Y. Toler | 15 | 22 | 1.28 | 3.30 | 28 |
| January 31 | do | 15 | 23 | .96 | 3.20 | 22 |
| February 2 | do | 15 | 22 | .93 | 3.20 | 20 |
| February 16 | do | 15 | 24 | 1.09 | 3.22 | 26 |
| March 4 | do | 15 | 24 | 1.00 | 3.20 | 24 |
| March 5 | do | 15 | 24 | 1.00 | 3.20 | 24 |
| March 16 | do | 15 | 24 | 1.02 | 3.22 | 25 |
| March 17 | do | 15 | 32 | 2.16 | 3.70 | 69 |
| March 29 | do | 15 | 21 | 1.43 | 3.30 | 30 |
| March 31 | do | 15 | 21 | 1.42 | 3.30 | 30 |
| April 13 | do | 15 | 22 | 1.18 | 3.25 | 26 |
| April 22 | do | 15 | 19 | 1.19 | 3.20 | 23 |
| May 12 | do | 15 | 25 | 1.40 | 3.32 | 35 |
| May 13 | do | 15 | 26 | 1.46 | 3.35 | 38 |
| May 25 | do | 15 | 21 | 1.05 | 3.22 | 22 |
| May 26 | do | 15 | 22 | .95 | 3.19 | 21 |
| June 4 | do | 15 | 28 | 1.68 | 3.50 | 47 |
| June 5 | do | 15 | 26 | 1.50 | 3.40 | 39 |
| June 6 | do | 15 | 25 | 1.28 | 3.30 | 32 |
| June 17 | do | 15 | 22 | 1.18 | 3.20 | 26 |
| June 19 | do | 15 | 22 | 1.09 | 3.15 | 24 |
| July 1 | do | 3 | 4.4 | 3.84 | 3.10 | 16.9 |
| July 13 | do | 8 | 10.0 | 1.74 | 3.20 | 17.4 |
| July 14 | do | 8 | 10.0 | 1.74 | 3.20 | 17.4 |
| July 26 | do | 8 | 9.6 | 1.72 | 3.15 | 16.5 |
| August 15 | do | 8 | 10.0 | 1.70 | 3.15 | 17 |
| August 24 | do | 16 | 7.2 | 1.43 | 3.00 | 10.3 |
| September 5 | do | 21 | 13 | 1.02 | 3.10 | 13.2 |
| September 6 | do | 21 | 13.7 | 1.04 | 3.10 | 14.2 |
| September 14 | do | 17 | 7.4 | 1.53 | 3.10 | 11.3 |
| September 15 | do | 17 | 7.8 | 1.49 | 3.10 | 11.6 |
| October 3 | do | 18 | 8.4 | 1.65 | 3.10 | 13.9 |
| October 12 | do | 19 | 10.1 | 1.59 | 3.20 | 17.1 |
| October 13 | do | 19 | 10.4 | 1.68 | 3.20 | 17.5 |
| October 21 | do | 18 | 7.6 | 1.72 | 3.10 | 13.1 |
| October 22 | do | 18 | 7.8 | 1.73 | 3.10 | 13.5 |
| November 1 | do | 13 | 11.4 | 1.24 | 3.20 | 14.0 |
| November 14 | do | 13 | 11.0 | 1.32 | 3.20 | 14.5 |
| November 15 | do | 13 | 11.0 | 1.30 | 3.20 | 14.3 |

NOTE.—After July 1 gagings were made near upper gage.

*Daily gage height, in feet, of West Valley Creek near Likely, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.3 | 3.2 | 3.2 | 4.5 | 3.15 | 3.2 | 3.2 | 3.2 | 3.0 | [a] 3.1 | 3.15 | 3.1 |
| 2 | 3.3 | 3.2 | 3.2 | 3.4 | 3.15 | 3.2 | 3.2 | 3.2 | 3.0 | [a] 3.1 | 3.15 | 3.1 |
| 3 | 3.25 | 3.2 | 3.2 | 3.3 | 3.15 | 3.2 | 3.2 | 3.2 | 3.0 | [a] 3.1 | 3.15 | 3.15 |
| 4 | 3.25 | 3.2 | 3.15 | 3.3 | 3.15 | 3.2 | 3.2 | 3.2 | 3.1 | [a] 3.1 | 3.2 | 3.15 |
| 5 | 3.25 | 3.2 | 3.15 | 3.3 | 3.15 | 3.6 | 3.2 | 3.2 | 3.1 | [a] 3.1 | 3.2 | 3.15 |
| 6 | 3.2 | 3.2 | [a] 3.15 | 3.3 | 3.15 | 3.5 | 3.2 | 3.2 | 3.1 | [a] 3.1 | 3.2 | 3.15 |
| 7 | 3.2 | 3.2 | [a] 3.15 | 3.25 | 3.15 | 3.45 | 3.2 | 3.2 | 3.1 | [a] 3.1 | 3.2 | 3.15 |
| 8 | 3.2 | 3.2 | [a] 3.15 | 3.25 | 3.3 | 3.55 | 3.2 | 3.2 | 3.1 | [a] 3.2 | 3.2 | 3.1 |
| 9 | 3.2 | 3.2 | [a] 3.1 | 3.25 | 3.2 | 3.55 | 3.15 | 3.2 | 3.1 | [a] 3.2 | 3.2 | 3.15 |
| 10 | 3.2 | 3.2 | [a] 3.1 | 3.25 | 3.4 | 3.3 | 3.15 | 3.2 | 3.1 | [a] 3.2 | 3.2 | 3.15 |
| 11 | 3.2 | 3.2 | 3.1 | 3.25 | 3.3 | 3.3 | 3.15 | 3.2 | 3.1 | [a] 3.2 | 3.2 | 3.1 |
| 12 | 3.2 | 3.2 | 3.1 | 3.25 | 3.25 | 3.25 | 3.15 | 3.2 | 3.2 | [a] 3.2 | 3.2 | 3.15 |
| 13 | 3.2 | 3.2 | 3.15 | 3.25 | 3.2 | 3.25 | 3.15 | 3.2 | 3.2 | [a] 3.2 | 3.2 | 3.1 |
| 14 | 3.2 | 3.2 | 3.2 | 3.25 | 3.2 | 3.2 | 3.15 | 3.0 | 3.2 | [a] 3.2 | 3.2 | 3.25 |
| 15 | 3.2 | 3.2 | 3.2 | 3.3 | 3.2 | 3.2 | 3.15 | 3.0 | 3.2 | [a] 3.2 | 3.2 | 3.15 |
| 16 | 3.2 | 3.2 | 3.2 | 3.3 | 3.2 | 3.2 | 3.15 | 3.0 | 3.2 | [a] 3.2 | 3.2 | 3.1 |
| 17 | 3.25 | 3.2 | 3.65 | 3.3 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | [a] 3.2 | 3.2 | 3.15 |
| 18 | 3.25 | 3.2 | 3.4 | 3.25 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | [a] 3.1 | 3.2 | 3.1 |
| 19 | 3.3 | 3.2 | 3.5 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | [a] 3.1 | 3.2 | 3.1 |
| 20 | 3.3 | 3.2 | 3.35 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | [a] 3.1 | 3.6 | 3.15 |
| 21 | 3.3 | 3.2 | 3.5 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | [a] 3.1 | 3.4 | 3.1 |
| 22 | 3.25 | 3.2 | 3.5 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.8 | 3.1 |
| 23 | 3.2 | 3.2 | 3.35 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.25 | 3.15 |
| 24 | 3.2 | 3.2 | 3.3 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.1 | 3.1 |
| 25 | 3.2 | 3.2 | 3.3 | 3.2 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.1 | 3.15 |
| 26 | 3.2 | 3.2 | 3.4 | 3.15 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.1 | 3.1 |
| 27 | 3.2 | 3.2 | 3.7 | 3.15 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.15 | 3.1 |
| 28 | 3.2 | 3.2 | 3.4 | 3.15 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.2 | 3.1 |
| 29 | 3.2 | ....... | 3.35 | 3.15 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.1 | 3.15 |
| 30 | 3.2 | ....... | 3.4 | 3.15 | 3.2 | 3.2 | 3.15 | 3.0 | [a] 3.2 | 3.1 | 3.1 | 3.1 |
| 31 | 3.2 | ....... | 3.5 | ....... | 3.2 | ....... | 3.2 | 3.0 | ....... | 3.1 | ....... | 3.6 |

[a] Estimated.

*Daily discharge, in second-feet, of West Valley Creek near Likely, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28 | 21 | 24 | 188 | 22 | 23 | 20 | 20 | 10 | 16 | 12 |
| 2 | 28 | 20 | 24 | 38 | 22 | 23 | 20 | 20 | 9 | 15 | 12 |
| 3 | 25 | 20 | 24 | 30 | 22 | 24 | 20 | 20 | 9 | 14 | 12 |
| 4 | 25 | 20 | 24 | 30 | 22 | 24 | 19 | 20 | 13 | 14 | 14 |
| 5 | 25 | 21 | 24 | 30 | 23 | 57 | 19 | 20 | 13 | 14 | 14 |
| 6 | 22 | 21 | 21 | 30 | 23 | 47 | 19 | 20 | 14 | 15 | 14 |
| 7 | 22 | 21 | 21 | 26 | 23 | 43 | 18 | 20 | 14 | 15 | 14 |
| 8 | 22 | 22 | 21 | 26 | 32 | 52 | 18 | 20 | 13 | 16 | 14 |
| 9 | 22 | 22 | 19 | 26 | 26 | 52 | 16 | 20 | 13 | 16 | 15 |
| 10 | 22 | 22 | 19 | 26 | 42 | 32 | 16 | 20 | 12 | 16 | 15 |
| 11 | 22 | 23 | 19 | 26 | 33 | 32 | 15 | 20 | 12 | 17 | 15 |
| 12 | 22 | 23 | 19 | 26 | 30 | 29 | 15 | 20 | 26 | 17 | 15 |
| 13 | 22 | 24 | 21 | 26 | 27 | 29 | 15 | 20 | 26 | 18 | 14 |
| 14 | 22 | 24 | 24 | 26 | 27 | 26 | 15 | 11 | 26 | 18 | 14 |
| 15 | 22 | 25 | 25 | 30 | 27 | 26 | 15 | 11 | 26 | 17 | 14 |
| 16 | 22 | 26 | 25 | 30 | 26 | 26 | 15 | 11 | 26 | 16 | 14 |
| 17 | 25 | 26 | 63 | 30 | 26 | 26 | 15 | 10 | 26 | 16 | 14 |
| 18 | 25 | 26 | 38 | 26 | 26 | 26 | 15 | 10 | 25 | 15 | 14 |
| 19 | 28 | 26 | 48 | 23 | 24 | 26 | 16 | 10 | 24 | 14 | 14 |
| 20 | 28 | 26 | 34 | 23 | 24 | 26 | 16 | 10 | 24 | 14 | ...... |
| 21 | 28 | 26 | 48 | 23 | 24 | 25 | 16 | 10 | 23 | 13 | ...... |
| 22 | 25 | 26 | 48 | 23 | 23 | 25 | 16 | 10 | 22 | 14 | ...... |
| 23 | 22 | 25 | 34 | 23 | 23 | 24 | 16 | 10 | 21 | 14 | ...... |
| 24 | 22 | 25 | 30 | 23 | 21 | 24 | 16 | 10 | 21 | 13 | ...... |
| 25 | 22 | 25 | 30 | 23 | 21 | 23 | 16 | 10 | 20 | 13 | ...... |
| 26 | 22 | 25 | 38 | 21 | 21 | 23 | 17 | 10 | 20 | 12 | ...... |
| 27 | 22 | 25 | 69 | 21 | 21 | 22 | 17 | 10 | 19 | 12 | ...... |
| 28 | 22 | 25 | 38 | 21 | 21 | 22 | 17 | 10 | 18 | 11 | ...... |
| 29 | 22 | ....... | 34 | 21 | 22 | 21 | 17 | 10 | 18 | 11 | ...... |
| 30 | 22 | ....... | 38 | 21 | 22 | 21 | 17 | 10 | 17 | 10 | ...... |
| 31 | 22 | ....... | 48 | ....... | 23 | ....... | 20 | 10 | ....... | 10 | ...... |

NOTE.—Daily discharge obtained by indirect method for shifting channel, as no measurements were made later than November 19. No estimate has been made for the remainder of the year.

*Estimated monthly discharge of West Valley Creek near Likely, Cal., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 28 | 22 | 23.5 | 1,445 |
| February | 26 | 20 | 23.6 | 1,311 |
| March | 69 | 19 | 32.0 | 1,968 |
| April | 188 | 21 | 31.2 | 1,856 |
| May | 42 | 21 | 24.8 | 1,525 |
| June | 57 | 21 | 29.3 | 1,744 |
| July | 20 | 15 | 16.8 | 1,033 |
| August | 20 | 10 | 14.3 | 879 |
| September | 26 | 9 | 18.7 | 1,113 |
| October | 18 | 10 | 14.4 | 885 |
| November 1-19 | 15 | 12 | 13.9 | 527 |
| The period | | | | 14,290 |

### ASH CREEK AT ADIN, CAL.

This station was established March 13, 1904, by J. S. Evans and William Busch. It was originally located one-fourth of a mile above the town of Adin. During the summer the closing of the waste gates in the dam at Adin interfered with the discharge at this point to such an extent that on August 15, 1904, the station was reestablished at a point 100 feet below the wagon bridge in the town of Adin, Cal., which is about 500 feet below the dam.

The channel is straight for 200 feet above and 200 feet below the station. The left bank is high, but the right bank is subject to overflow from the side channel which, in flood diverts water from above the station. The bed of the stream is gravelly and not subject to change.

Discharge measurements are made from a suspension footbridge constructed with one-half inch cables.

The gage is a vertical plank fastened to a tree on the left bank of the stream. During 1905 the gage was read once each day by H. Williams.

A description of this station, with gage heights and discharged data, is contained in Water Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Ash Creek River at Adin, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 7 | J. Y. Toler | 32 | 50 | 0.90 | 1.96 | 45 |
| January 21 | do | 34 | 69 | 1.23 | 2.40 | 85 |
| January 25 | do | 35 | 92 | 1.35 | 2.89 | 124 |
| Do | do | 35 | 95 | 1.33 | 3.00 | 126 |
| February 8 | do | 34 | 70 | .99 | 2.30 | 69 |
| February 11 | do | 36 | 78 | 1.47 | 2.80 | 115 |
| February 12 | do | 36 | 76 | 1.30 | 2.50 | 99 |
| February 23 | do | 36 | 108 | 1.57 | 3.30 | 170 |
| February 26 | do | 36 | 93 | 1.44 | 2.90 | 134 |
| March 10 | do | 35 | 67 | 1.07 | 2.30 | 72 |
| March 12 | do | 35 | 67 | 1.10 | 2.30 | 74 |
| March 13 | do | 35 | 68 | 1.16 | 2.35 | 79 |
| March 25 | do | 36 | 114 | 1.27 | 3.60 | 145 |
| April 5 | do | 36 | 125 | 1.85 | 3.95 | 231 |
| April 8 | do | 36 | 107 | 1.72 | 3.55 | 183 |
| Do | do | 36 | 103 | 1.65 | 3.40 | 171 |
| April 16 | do | 35 | 82 | 1.45 | 2.80 | 119 |
| April 18 | do | 35 | 79 | 1.34 | 2.70 | 106 |
| May 2 | do | 35 | 80 | 1.33 | 2.70 | 106 |
| May 3 | do | 34 | 60 | .98 | 2.20 | 59 |
| May 4 | do | 34 | 63 | 1.08 | 2.10 | 68 |
| May 17 | do | 33 | 56 | .86 | 1.90 | 48 |
| May 18 | do | 33 | 54 | .85 | 1.90 | 46 |
| May 19 | do | 33 | 53 | .79 | 1.85 | 42 |
| May 20 | do | 33 | 53 | .76 | 1.80 | 40 |
| June 10 | do | 45 | 28 | 1.08 | 1.80 | 30 |
| June 11 | do | 45 | 27 | 1.05 | 1.75 | 28 |
| June 13 | do | 44 | 26 | .96 | 1.70 | 25 |
| July 6 | do | 28 | 22 | .93 | 1.65 | 20 |
| July 18 | do | 28 | 23 | .91 | 1.65 | 21 |
| July 21 | do | 26 | 18.9 | 1.22 | 1.70 | 23 |
| August 8 | do | 25 | 15.4 | 1.28 | 1.60 | 19.7 |
| August 10 | do | 25 | 15.4 | 1.29 | 1.60 | 19.9 |
| August 17 | do | 28 | 19.2 | 1.10 | 1.65 | 20 |
| August 20 | do | 28 | 18.4 | .98 | 1.60 | 18.1 |
| August 29 | do | 27 | 16.7 | .89 | 1.50 | 14.9 |
| August 30 | do | 27 | 16.7 | .83 | 1.50 | 13.8 |
| September 10 | do | 28 | 19.2 | .98 | 1.60 | 18.9 |
| September 11 | do | 29 | 21 | 1.05 | 1.70 | 22 |
| September 20[a] | do | 7 | 2.5 | .92 | 1.00 | 2.3 |
| September 21 | do | 32 | 49 | .49 | 1.70 | 24 |
| October 8 | do | 30 | 19.2 | 1.67 | 1.70 | 32 |
| October 9 | do | 32 | 50 | .59 | 1.70 | 29 |
| October 17 | do | 30 | 19.2 | 1.41 | 1.70 | 27 |
| October 18 | do | 34 | 51 | .63 | 1.80 | 32 |
| October 26 | do | 26 | 50 | .63 | 1.80 | 31 |
| October 28 | do | 36 | 57 | .87 | 2.00 | 50 |
| November 8 | do | 34 | 50 | .64 | 1.80 | 32 |
| November 9 | do | 35 | 53 | .84 | 1.90 | 44 |

[a] Water held back by dam above station.

*Daily gage height, in feet, of Ash Creek at Adin, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 3.4 | 2.5 | 4.1 | 2.3 | 1.9 | 1.7 | 1.5 | 1.6 | 1.7 | 1.9 | 1.8 |
| 2 | 2.4 | 5.9 | 2.5 | 6.0 | 2.2 | 1.9 | 1.7 | 1.6 | 1.7 | 1.7 | 1.9 | 1.8 |
| 3 | 2.2 | 3.5 | 2.5 | 6.0 | 2.1 | 1.9 | 1.7 | 1.6 | 1.7 | 1.7 | 1.9 | 1.8 |
| 4 | 1.9 | 3.4 | 2.5 | 4.6 | 2.1 | 1.9 | 1.6 | 1.6 | 1.7 | 1.7 | 1.9 | 1.8 |
| 5 | 1.9 | 3.4 | 2.5 | 4.6 | 2.1 | 1.9 | 1.5 | 1.6 | 1.7 | 1.7 | 1.9 | 1.8 |
| 6 | 1.9 | 3.4 | 2.5 | 4.0 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.7 | 1.9 | 1.8 |
| 7 | 1.9 | 3.4 | 2.5 | 3.7 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.7 | 1.9 | 1.8 |
| 8 | 1.9 | 3.2 | 2.5 | 3.7 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.7 | 1.9 | 1.8 |
| 9 | 1.9 | 2.5 | 2.4 | 3.2 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.7 | 1.9 | 1.8 |
| 10 | 1.9 | 2.4 | 2.4 | 3.2 | 2.2 | 1.8 | 1.5 | 1.6 | 1.9 | 1.8 | 1.9 | 1.8 |
| 11 | 1.9 | 2.3 | 2.4 | 3.1 | 2.2 | 1.8 | 1.5 | 1.6 | 1.9 | 1.8 | 1.9 | 1.8 |
| 12 | 1.9 | 2.3 | 2.4 | 3.1 | 2.2 | 1.8 | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 1.8 |
| 13 | 2.0 | 2.2 | 2.4 | 3.0 | 2.2 | 1.8 | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 1.8 |
| 14 | 2.0 | 2.1 | 2.4 | 3.0 | 2.2 | 1.8 | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 1.8 |
| 15 | 2.0 | 2.1 | 2.4 | 3.0 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 1.8 |
| 16 | 4.0 | 2.1 | 2.4 | 3.0 | 2.1 | 1.8 | 1.5 | 1.6 | 1.8 | 1.9 | 1.8 | 1.8 |
| 17 | 2.5 | 2.2 | 3.1 | 2.8 | 2.1 | 1.8 | 1.5 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 |
| 18 | 2.0 | 3.1 | 5.1 | 2.8 | 2.2 | 1.8 | 1.5 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 |
| 19 | 2.8 | 5.9 | 6.2 | 2.8 | 2.2 | 1.8 | 1.5 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 |
| 20 | 2.4 | 6.0 | 4.3 | 2.8 | 2.3 | 1.8 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.8 |
| 21 | 2.4 | 3.4 | 4.6 | 2.8 | 2.3 | 1.7 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.8 |
| 22 | 4.1 | 3.3 | 4.6 | 2.8 | 2.3 | 1.7 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.8 |
| 23 | 4.6 | 3.3 | 3.8 | 2.7 | 2.1 | 1.7 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.8 |
| 24 | 4.6 | 2.6 | 5.4 | 2.7 | 2.1 | 1.7 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.8 |
| 25 | 3.0 | 2.6 | 3.6 | 2.7 | 1.9 | 1.7 | 1.5 | 1.7 | 1.6 | 1.7 | 1.8 | 1.8 |
| 26 | 2.4 | 2.3 | 9.0 | 2.7 | 1.9 | 1.7 | 1.5 | 1.7 | 1.6 | 1.7 | 1.8 | 1.8 |
| 27 | 2.3 | 2.3 | 4.6 | 2.7 | 1.9 | 1.7 | 1.5 | 1.7 | 1.6 | 1.8 | 1.8 | 1.8 |
| 28 | 2.3 | 2.5 | 4.1 | 2.8 | 1.9 | 1.7 | 1.5 | 1.6 | 1.6 | 1.8 | 1.8 | 1.8 |
| 29 | 2.3 | ....... | 4.2 | 2.8 | 1.9 | 1.7 | 1.5 | 1.6 | 1.6 | 1.8 | 1.8 | 1.8 |
| 30 | 4.5 | ....... | 4.2 | 2.8 | 1.9 | 1.7 | 1.5 | 1.6 | 1.6 | 1.8 | 1.8 | 1.8 |
| 31 | 4.5 | ....... | 4.1 | ....... | 1.9 | ....... | 1.5 | 1.6 | ....... | 1.9 | ....... | 1.8 |

*Station rating table for Ash Creek at Adin, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 14 | 2.60 | 97 | 3.70 | 205 | 4.80 | 342 |
| 1.60 | 20 | 2.70 | 106 | 3.80 | 216 | 4.90 | 356 |
| 1.70 | 27 | 2.80 | 115 | 3.90 | 227 | 5.00 | 370 |
| 1.80 | 34 | 2.90 | 124 | 4.00 | 238 | 5.20 | 400 |
| 1.90 | 41 | 3.00 | 134 | 4.10 | 250 | 5.40 | 430 |
| 2.00 | 48 | 3.10 | 144 | 4.20 | 262 | 5.60 | 462 |
| 2.10 | 56 | 3.20 | 154 | 4.30 | 274 | 5.80 | 494 |
| 2.20 | 64 | 3.30 | 164 | 4.40 | 287 | 6.00 | 526 |
| 2.30 | 72 | 3.40 | 174 | 4.50 | 300 | 6.20 | 560 |
| 2.40 | 80 | 3.50 | 184 | 4.60 | 314 | | |
| 2.50 | 88 | 3.60 | 194 | 4.70 | 328 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 49 discharge measurements made during 1905. It is well defined between gage heights 1.5 feet and 4 feet. Above 4 feet the table is a rough approximation.

*Estimated monthly discharge of Ash Creek at Adin, Cal., for 1905.*

[Drainage area, 260 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 314 | 41 | 107 | 6,579 | 0.412 | 0.475 |
| February | 526 | 56 | 158 | 8,775 | .608 | .633 |
| March | 1,120 | 80 | 214 | 13,160 | .823 | .949 |
| April | 526 | 106 | 176 | 10,470 | .677 | .755 |
| May | 72 | 41 | 56.7 | 3,486 | .218 | .251 |
| June | 41 | 27 | 32.8 | 1,952 | .126 | .141 |
| July | 27 | 14 | 15.5 | 953 | .060 | .069 |
| August | 27 | 14 | 20.5 | 1,260 | .079 | .091 |
| September | 41 | 20 | 27.2 | 1,618 | .105 | .117 |
| October | 41 | 27 | 31.1 | 1,912 | .120 | .138 |
| November | 41 | 34 | 37.5 | 2,231 | .144 | .161 |
| December | 34 | 34 | 34 | 2,091 | .131 | .151 |
| The year | 1,120 | 14 | 75.9 | 54,490 | .292 | 3.93 |

## McCLOUD RIVER NEAR GREGORY, CAL.

This station was established March 23, 1902, in cooperation with the McCloud River Electric Company. It is located at John's Camp, near Hirze Mountain, 14 miles east of Gregory Post-office, Cal. Baird Station, on the Southern Pacific Railroad, is just across Sacramento River from Gregory.

The channel is straight for 300 feet above and 600 feet below the gaging station. The current is swift at all stages. The banks are high and wooded and not liable to overflow. The bed is composed of limestone on the sides, with some large river gravel and bowlders in the center of the channel.

Measurements are made from a car suspended from a cable. The initial point for soundings is at the gage rod on the right bank of the stream. A line is placed 150 feet below the cable, marking a course for float measurements during floods.

The gage rod is a timber nailed and wired to a tree on the right bank. The bench mark is a point marked with a ring of white paint on the top of a bowlder 10 feet upstream from the 10-foot mark on the cable; elevation, 21.19 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of McCloud River near Gregory, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 21 | O. W. Peterson | 114 | 830 | 6.43 | 4.58 | 5,337 |
| February 22 | do | 114 | 759 | 5.47 | 3.95 | 4,155 |
| February 22 | do | 114 | 766 | 5.38 | 3.98 | 4,120 |
| August 6 | Peterson & Lee | 103 | 543 | 2.55 | 1.63 | 1,386 |

*Daily gage height, in feet, of McCloud River near Gregory, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.9 | 3.85 | 2.9 | 3.4 | 2.8 | 2.1 | 1.8 | 1.65 | 1.55 | 1.55 | 1.5 | 1.55 |
| 2 | 2.6 | 4.5 | 2.8 | 3.3 | 2.7 | 2.2 | 1.8 | 1.65 | 1.55 | 1.55 | 1.5 | 1.55 |
| 3 | 2.45 | 3.85 | 2.8 | 3.25 | 2.65 | 2.1 | 1.8 | 1.65 | 1.55 | 1.55 | 1.5 | 1.55 |
| 4 | 2.3 | 3.7 | 2.75 | 3.2 | 2.6 | 2.1 | 1.8 | 1.65 | 1.55 | 1.55 | 1.5 | 1.55 |
| 5 | 2.2 | 3.6 | 2.7 | 3.1 | 2.5 | 2.1 | 1.8 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 6 | 2.2 | 3.6 | 2.7 | 3.0 | 2.6 | 2.05 | 1.8 | 1.65 | 1.55 | 1.55 | 1.5 | 1.55 |
| 7 | 2.15 | 3.5 | 2.65 | 2.9 | 2.7 | 2.05 | 1.8 | 1.6 | 1.55 | 1.6 | 1.5 | 1.55 |
| 8 | 2.1 | 3.3 | 2.65 | 2.85 | 2.8 | 2.0 | 1.8 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 9 | 2.0 | 3.2 | 2.6 | 2.8 | 2.7 | 2.0 | 1.8 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 10 | 2.0 | 3.1 | 2.6 | 2.7 | 2.7 | 2.0 | 1.8 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 11 | 2.0 | 3.0 | 2.7 | 2.7 | 2.7 | 2.0 | 1.8 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 12 | 1.95 | 2.95 | 3.05 | 2.6 | 2.6 | 2.0 | 1.75 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 13 | 2.05 | 2.7 | 4.6 | 2.6 | 2.6 | 1.95 | 1.75 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 14 | 3.1 | 2.6 | 6.8 | 2.55 | 2.55 | 1.95 | 1.75 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 15 | 3.25 | 2.5 | 5.25 | 2.6 | 2.5 | 1.9 | 1.75 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 16 | 3.3 | 2.5 | 4.6 | 2.8 | 2.5 | 1.9 | 1.7 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 17 | 3.1 | 2.4 | 4.15 | 2.6 | 2.5 | 1.9 | 1.7 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 18 | 3.0 | 2.5 | 4.0 | 2.75 | 2.5 | 1.9 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 19 | 3.0 | 3.4 | 4.4 | 2.9 | 2.4 | 1.9 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.6 |
| 20 | 2.95 | 5.3 | 4.7 | 2.85 | 2.4 | 1.9 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 21 | 4.1 | 4.7 | 5.2 | 2.8 | 2.3 | 1.85 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 22 | 8.05 | 3.9 | 4.7 | 2.8 | 2.25 | 1.85 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 23 | 7.4 | 3.6 | 4.35 | 2.7 | 2.3 | 1.85 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 24 | 6.2 | 3.35 | 4.0 | 2.7 | 2.2 | 1.85 | 1.7 | 1.6 | 1.55 | 1.55 | 1.5 | 1.55 |
| 25 | 6.6 | 3.1 | 3.8 | 2.7 | 2.2 | 1.85 | 1.7 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 26 | 5.15 | 3.1 | 4.3 | 2.7 | 2.2 | 1.85 | 1.65 | 1.6 | 1.55 | 1.55 | 1.55 | 1.55 |
| 27 | 4.25 | 3.0 | 4.0 | 2.7 | 2.2 | 1.8 | 1.65 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 |
| 28 | 3.8 | 2.9 | 3.9 | 2.6 | 2.2 | 1.8 | 1.65 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 |
| 29 | 3.45 | | 3.9 | 2.6 | 2.2 | 1.8 | 1.65 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 |
| 30 | 3.25 | | 3.6 | 2.7 | 2.2 | 1.8 | 1.65 | 1.55 | 1.55 | 1.55 | 1.55 | 1.55 |
| 31 | 3.25 | | 3.6 | | 2.1 | | 1.65 | 1.55 | | 1.5 | | 1.55 |

*Station rating table for McCloud River near Gregory, Cal., from September 23, 1902, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 1,090 | 2.40 | 2,042 | 3.80 | 3,860 | 5.40 | 7,170 |
| 1.10 | 1,132 | 2.50 | 2,140 | 3.90 | 4,030 | 5.60 | 7,630 |
| 1.20 | 1,178 | 2.60 | 2,242 | 4.00 | 4,210 | 5.80 | 8,110 |
| 1.30 | 1,228 | 2.70 | 2,349 | 4.10 | 4,395 | 6.00 | 8,600 |
| 1.40 | 1,282 | 2.80 | 2,461 | 4.20 | 4,585 | 6.20 | 9,120 |
| 1.50 | 1,340 | 2.90 | 2,578 | 4.30 | 4,785 | 6.40 | 9,650 |
| 1.60 | 1,402 | 3.00 | 2,700 | 4.40 | 4,990 | 6.60 | 10,190 |
| 1.70 | 1,468 | 3.10 | 2,825 | 4.50 | 5,200 | 6.80 | 10,740 |
| 1.80 | 1,538 | 3.20 | 2,955 | 4.60 | 5,410 | 7.00 | 11,300 |
| 1.90 | 1,612 | 3.30 | 3,090 | 4.70 | 5,625 | 7.20 | 11,870 |
| 2.00 | 1,690 | 3.40 | 3,230 | 4.80 | 5,840 | 7.40 | 12,450 |
| 2.10 | 1,772 | 3.50 | 3,380 | 4.90 | 6,060 | 7.60 | 13,040 |
| 2.20 | 1,858 | 3.60 | 3,535 | 5.00 | 6,280 | 7.80 | 13,640 |
| 2.30 | 1,948 | 3.70 | 3,695 | 5.20 | 6,720 | 8.00 | 14,250 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1902-1905. It is fairly well defined between gage heights 1.5 feet and 4.6 feet. The table has been extended beyond these limits. Above 8 feet the discharge is a rough approximation.

*Estimated monthly discharge of McCloud River near Gregory, Cal., for 1902–1905.*

[Drainage, 608 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| **1902** | | | | | | |
| September 23 to 30 | 1,340 | 1,282 | 1,333 | 21,150 | 2.19 | 0.651 |
| October | 2,140 | 1,228 | 1,372 | 84,360 | 2.26 | 2.61 |
| November | 12,740 | 1,282 | 2,799 | 166,600 | 4.60 | 5.13 |
| December | 6,060 | 1,538 | 2,576 | 158,400 | 4.24 | 4.89 |
| **1903** | | | | | | |
| January | 13,340 | 1,538 | 2,847 | 175,100 | 4.68 | 5.40 |
| February | 2,578 | 1,772 | 2,046 | 113,600 | 3.37 | 3.51 |
| March | 11,870 | 2,042 | 3,723 | 228,900 | 6.12 | 7.06 |
| April | 6,060 | 2,242 | 2,819 | 167,700 | 4.64 | 5.18 |
| May | 2,242 | 1,612 | 1,913 | 117,600 | 3.15 | 3.63 |
| June | 1,690 | 1,468 | 1,545 | 91,930 | 2.54 | 2.83 |
| July | 1,468 | 1,340 | 1,373 | 84,420 | 2.26 | 2.61 |
| August | 1,352 | 1,311 | 1,323 | 81,350 | 2.18 | 2.51 |
| September | 1,311 | 1,282 | 1,305 | 77,650 | 2.15 | 2.40 |
| October | 1,435 | 1,282 | 1,317 | 80,980 | 2.17 | 2.50 |
| November | 14,560 | 1,282 | 3,475 | 206,800 | 5.72 | 6.38 |
| December | 2,263 | 1,455 | 1,829 | 112,500 | 3.01 | 3.47 |
| The year | 14,560 | 1,282 | 2,126 | 1,539,000 | 3.50 | 47.48 |
| **1904** | | | | | | |
| January | 2,042 | 1,503 | 1,652 | 101,600 | 2.72 | 3.14 |
| February | 39,500 | 1,468 | 6,153 | 353,900 | 10.12 | 10.92 |
| March | 41,000 | 3,380 | 9,310 | 572,400 | 15.31 | 17.65 |
| April | 7,285 | 4,120 | 5,468 | 325,400 | 8.99 | 10.03 |
| May | 4,490 | 3,090 | 3,756 | 230,900 | 6.18 | 7.12 |
| June | 2,890 | 1,858 | 2,218 | 132,000 | 3.65 | 4.07 |
| July | 1,858 | 1,612 | 1,746 | 107,400 | 2.87 | 3.31 |
| August | 1,612 | 1,503 | 1,572 | 96,660 | 2.59 | 2.99 |
| September | 1,815 | 1,468 | 1,512 | 89,970 | 2.49 | 2.78 |
| October | 9,785 | 1,503 | 2,697 | 165,800 | 4.44 | 5.12 |
| November | 2,140 | 1,503 | 1,640 | 97,590 | 2.70 | 3.01 |
| December | 4,585 | 1,575 | 1,844 | 113,400 | 3.03 | 3.49 |
| The year | 41,000 | 1,468 | 3,297 | 2,387,000 | 5.42 | 73.63 |
| **1905** | | | | | | |
| January | 14,400 | 1,651 | 3,854 | 237,000 | 6.34 | 7.31 |
| February | 6,945 | 2,042 | 3,284 | 182,400 | 5.40 | 5.62 |
| March | 10,740 | 2,242 | 4,062 | 249,800 | 6.68 | 7.70 |
| April | 3,230 | 2,191 | 2,490 | 148,200 | 4.10 | 4.57 |
| May | 2,461 | 1,772 | 2,112 | 129,900 | 3.47 | 4.00 |
| June | 1,858 | 1,538 | 1,648 | 98,060 | 2.71 | 3.02 |
| July | 1,538 | 1,435 | 1,491 | 91,680 | 2.45 | 2.82 |
| August | 1,435 | 1,371 | 1,402 | 86,210 | 2.31 | 2.66 |
| September | 1,371 | 1,371 | 1,371 | 81,580 | 2.25 | 2.51 |
| October | 1,402 | 1,340 | 1,371 | 84,300 | 2.25 | 2.59 |
| November | 1,371 | 1,340 | 1,352 | 80,450 | 2.22 | 2.48 |
| December | 1,402 | 1,371 | 1,372 | 84,360 | 2.26 | 2.61 |
| The year | 14,400 | 1,340 | 2,151 | 1,554,000 | 3.54 | 47.89 |

### MISCELLANEOUS MEASUREMENTS IN PIT RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Pit River drainage basin during 1905:

*Cottonwood Creek, near Lakeview, Oreg.*—This stream is tributary to Goose Lake. A measurement was made June 28, 1905, by S. G. Bennett and J. Y. Toler, one-half mile below Wilshire's sawmill and 10 miles above Lakeview, Oreg.

Width, 12.7 feet; area, 4.7 square feet; mean velocity, 1.55 feet per second; discharge, 7.3 second-feet.

*Corporation ditch, near Likely, Cal.*—This ditch diverts water from the South Fork of Pit River above Likely, Cal. The following measurements were made below head-gate, 2 miles east of Likely, Cal.:

June 7: Width, 5.7 feet; area, 16.3 square feet; mean velocity, 1.42 feet per second; discharge, 23 second-feet.

June 20: Width, 5.6 feet; area, 16.6 square feet; mean velocity, 1.41 feet per second; discharge, 24 second-feet.

September 6: Width, 7.0 feet; area, 19.9 square feet; mean velocity, 1.46 feet per second; discharge, 29 second-feet.

*Duke's ditch, near Likely, Cal.*—This ditch diverts water from the South Fork of Pit River. The following measurements were made in flume, 400 yards below head-gate, by John Y. Toler:

June 7: Width, 3 feet; area, 2.88 square feet; mean velocity, 4.83 feet per second; discharge, 13.9 second-feet.

June 20: Width, 3 feet; area, 2.3 square feet; mean velocity, 4.25 feet per second; discharge, 9.8 second-feet.

*Fitz Hugh Creek, near Alturas, Cal.*—This creek is tributary to Pit River. The following measurements were made at Doten's ranch, 10 miles south of Alturas, by John Y. Toler:

July 2: Width, 8.5 feet; area, 2.8 square feet; mean velocity, 0.64 foot per second; discharge, 1.8 second-feet.

July 25: Width, 8.4 feet; area, 2.7 square feet; mean velocity, 0.52 foot per second; discharge, 1.4 second-feet.

September 7: Width, 7.0 feet; area, 2.8 square feet; mean velocity, 0.64 foot per second; discharge, 1.8 second-feet.

September 16: Width, 8 feet; area, 3.6 square feet; mean velocity, 0.78 foot per second; discharge, 2.8 second-feet.

*Ganstad's ditch, near Likely, Cal.*—This ditch diverts water from the South Fork of the Pit River. The following measurements were made at head-gate, 2 miles east of Likely, Cal., by John Y. Toler:

June 8: Width, 6.6 feet; area, 10.5 square feet; mean velocity, 0.66 foot per second; discharge, 6.9 second-feet.

July 2: Width, 6.6 feet; area, 10.5 square feet; mean velocity, 0.83 foot per second; discharge, 8.7 second-feet.

*Gooch's ditch, near Lookout, Cal.*—This ditch diverts water from Pit River. A measurement was made 250 yards above bridge at Lookout on June 13 by John Y. Toler.

Width, 14.5 feet; area, 25 square feet; mean velocity, 0.48 foot per second; discharge, 12 second-feet.

*E. Lauer and Son's ditch near Alturas, Cal.*—This ditch diverts water from Pit River above the town of Alturas, Cal. A measurement was made in flume at XL ranch, 9 miles north of the town of Alturas, Cal., on May 23, by Jno. Y. Toler.

Width, 4.1 feet; area, 0.89 square foot; mean velocity, 1.60 feet per second; discharge, 1.42 second-feet.

*Pine Creek near Alturas, Cal.*—This stream is a tributary of South Fork of Pit River. The following measurements were made in flume 100 feet below Gibbins & Mulkey's power house, 7 miles east of the town of Alturas, Cal.

August 11: Width, 2.2 feet; area, 2.8 square feet; mean velocity, 4.43 feet per second; discharge, 12.4 second-feet.

August 22: Width, 2.15 feet; area, 2.6 square feet; mean velocity, 4.35 feet per second; discharge, 11.3 second-feet.

October 1: Width, 2.3 feet; area, 3.1 square feet; mean velocity, 3.94 feet per second; discharge, 12.2 second-feet.

*Pit River at Lookout, Cal.*—The following measurements were made during 1905 at bridge on county road east of town of Lookout, Cal.

June 13: Width, 87 feet; area, 217 square feet; mean velocity, 0.71 foot per second; discharge, 155 second-feet.

July 7: Width, 67 feet; area, 112 square feet; mean velocity, 0.51 foot per second; discharge, 57 second-feet.

July 20: Width, 40 feet; area, 71 square feet; mean velocity, 0.41 foot per second; discharge, 29 second-feet.

August 19: Width, 8 feet; area, 4.8 square feet; mean velocity, 2.06 feet per second; discharge, 9.9 second-feet.

*Rush Creek near Adin, Cal.*—This stream is a tributary to Ash Creek. The following measurements were made in canyon above upper end of Round Valley north of the town of Alturas, Cal.

July 18: Width, 13 feet; area, 9.7 square feet; mean velocity, 0.56 foot per second; discharge, 5.6 second-feet.

September 22: Width, 9 feet; area, 5.0 square feet; mean velocity, 1.16 feet per second; discharge, 5.8 second-feet.

*Von Loam's ditch near Likely, Cal.*—This ditch diverts water from the South Fork of Pit River. The following measurements were made below head-gate, 2 miles east of the town of Likely, Cal.

June 8: Width, 7.8 feet; area, 16.9 square feet; mean velocity, 2.09 feet per second; discharge, 35 second-feet.

June 20: Width, 8.5 feet; area, 14.9 square feet; mean velocity, 1.68 feet per second; discharge, 25 second-feet.

*Willow Creek near Adin, Cal.*—This stream is tributary to Ash Creek. The following measurements were made at bridge on county road, 5 miles south of the town of Adin, Cal.

July 19: Width, 8 feet; area, 5.2 square feet; mean velocity, 1.09 feet per second; discharge, 5.7 second-feet.

September 21: Width, 8 feet; area, 4.4 square feet; mean velocity, 1.00 foot per second; discharge, 4.4 second-feet.

## STONY CREEK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Stony Creek drains a portion of the Coast Range and flowing in a northerly direction discharges its waters into the Sacramento River near Orland, Cal. It has numerous tributaries, all of which are torrential in their character. The formation on the higher elevations is of granite with good soil covering and is heavily timbered. In the lower portion of the drainage basin the formation is shale, sandstone, and conglomerate, with heavy growth of brush and grass. This portion of the basin is used extensively for pasturage, the soil being heavy, it packs readily, producing a large per cent of run-off. The mean average rainfall on the higher elevation is about 40 inches; while on the lower reaches it is 20 inches. The precipitation is almost wholly in the form of rain, with some snow on the upper reaches which soon melts and only adds to the flood discharge.

The gaging station on this stream is located near the point where it emerges from the foothills and enters the Sacramento Valley.

### STONY CREEK NEAR FRUTO, CAL.

This station was established on January 30, 1901, by Burt Cole. It is located at Julian's ranch, 7 miles northwest of Fruto, and 1¾ miles above the proposed mill-site dam.

The channel is straight for 200 feet above and below the cable. The current is very swift at high water and sluggish at low water. Neither bank is subject to overflow, but at high stages of the creek the water spreads to the right for several hundred feet. The bed of the stream is of gravel and is subject to some change.

Discharge measurements are made from a car and cable. The initial point for soundings is the eyebolt on the left bank to which the cable is attached.

The gage is in two sections. During 1905 the gage was read twice each day by W. H. Julian. The bench mark is the head of an iron bolt set in the rock near the upper gage; elevation, 14.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Stony Creek near Fruto, Cal., in 1905.*

| Date | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 16 | O. W. Peterson | 130 | 204 | 3.35 | 5.13 | 684 |
| June 23 | do | 110 | 84 | 1.52 | 3.90 | 128 |
| August 4 | Peterson and Lee | 32 | 23 | 1.22 | 3.30 | 28 |
| September 8 | C. H. Lee | 33 | 32 | .51 | 3.22 | 16.3 |
| September 14 | W. B. Clapp | 33 | 17 | .83 | 3.20 | 14.1 |
| October 4 | Lee and Hawley | 24 | 23 | .76 | 3.24 | 17.6 |

*Daily gage height, in feet, of Stony Creek near Fruto, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.0 | 10.0 | 5.2 | 6.1 | 4.7 | 4.6 | 3.7 | 3.2 | 3.1 | 3.2 | 3.3 | 3.6 |
| 2 | 6.8 | 8.75 | 5.2 | 6.0 | 5.0 | 4.5 | 3.6 | 3.2 | 3.1 | 3.2 | 3.3 | 3.6 |
| 3 | 6.6 | 7.35 | 5.1 | 6.0 | 5.0 | 4.5 | 3.6 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 4 | 6.3 | 6.7 | 5.1 | 5.9 | 5.0 | 4.6 | 3.6 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 5 | 6.2 | 6.2 | 5.0 | 5.9 | 4.9 | 4.5 | 3.6 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 6 | 6.1 | 6.0 | 5.0 | 5.8 | 4.8 | 4.5 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 7 | 5.0 | 5.8 | 5.0 | 5.8 | 6.3 | 4.4 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 8 | 4.9 | 5.6 | 4.9 | 5.7 | 5.75 | 4.4 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 9 | 4.9 | 5.5 | 4.9 | 5.6 | 5.5 | 4.3 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 10 | 4.8 | 5.4 | 4.9 | 5.5 | 5.5 | 4.3 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 11 | 4.8 | 5.4 | 4.8 | 5.4 | 5.4 | 4.2 | 3.5 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 12 | 4.8 | 5.3 | 6.4 | 5.3 | 5.4 | 4.2 | 3.4 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 13 | 4.7 | 5.3 | 8.25 | 5.3 | 5.3 | 4.2 | 3.4 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 14 | 9.5 | 5.2 | 7.75 | 5.2 | 5.3 | 4.1 | 3.4 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 15 | 7.75 | 5.2 | 8.5 | 5.2 | 5.2 | 4.1 | 3.4 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 16 | 8.5 | 5.1 | 8.5 | 5.3 | 5.2 | 4.1 | 3.3 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 17 | 7.8 | 5.5 | 7.7 | 5.3 | 5.1 | 4.1 | 3.3 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 18 | 7.7 | 5.8 | 7.15 | 5.3 | 5.0 | 4.1 | 3.3 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 19 | 7.4 | 5.7 | 9.25 | 5.2 | 4.9 | 4.0 | 3.3 | 3.2 | 3.2 | 3.2 | 3.3 | 3.6 |
| 20 | 6.8 | 6.0 | 8.25 | 5.2 | 4.9 | 4.0 | 3.3 | 3.1 | 3.2 | 3.2 | 3.3 | 3.6 |
| 21 | 6.8 | 5.8 | 7.3 | 5.0 | 4.8 | 4.0 | 3.3 | 3.1 | 3.2 | 3.2 | 3.3 | 3.6 |
| 22 | 9.75 | 5.6 | 6.75 | 5.0 | 4.8 | 3.9 | 3.3 | 3.1 | 3.2 | 3.2 | 3.3 | 3.6 |
| 23 | 9.25 | 5.5 | 6.55 | 5.0 | 4.7 | 3.9 | 3.3 | 3.1 | 3.2 | 3.2 | 3.3 | 3.6 |
| 24 | 9.5 | 5.4 | 7.25 | 4.9 | 4.7 | 3.9 | 3.3 | 3.1 | 3.2 | 3.3 | 3.3 | 3.6 |
| 25 | 7.7 | 5.4 | 6.6 | 4.9 | 4.6 | 3.8 | 3.3 | 3.1 | 3.2 | 3.3 | 3.4 | 3.6 |
| 26 | 6.9 | 5.3 | 6.55 | 4.9 | 4.9 | 3.8 | 3.3 | 3.1 | 3.2 | 3.3 | 3.4 | 3.6 |
| 27 | 6.45 | 5.3 | 6.3 | 4.8 | 5.25 | 3.8 | 3.3 | 3.1 | 3.2 | 3.3 | 3.4 | 3.8 |
| 28 | 6.3 | 5.2 | 6.1 | 4.8 | 4.8 | 3.7 | 3.3 | 3.1 | 3.2 | 3.3 | 3.4 | 3.8 |
| 29 | 6.1 | ....... | 7.35 | 4.8 | 4.8 | 3.7 | 3.3 | 3.1 | 3.2 | 3.3 | 3.6 | 3.8 |
| 30 | 6.0 | ....... | 6.5 | 4.7 | 4.7 | 3.7 | 3.2 | 3.1 | 3.2 | 3.3 | 3.6 | 3.8 |
| 31 | 6.0 | ....... | 6.15 | ....... | 4.6 | ....... | 3.2 | 3.1 | ....... | 3.3 | ....... | 3.8 |

*Station rating table for Stony Creek near Fruto, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 10 | 4.50 | 350 | 5.90 | 1,310 | 7.60 | 3,150 |
| 3.20 | 14 | 4.60 | 400 | 6.00 | 1,400 | 7.80 | 3,410 |
| 3.30 | 23 | 4.70 | 450 | 6.10 | 1,490 | 8.00 | 3,690 |
| 3.40 | 34 | 4.80 | 500 | 6.20 | 1,590 | 8.20 | 3,980 |
| 3.50 | 47 | 4.90 | 560 | 6.30 | 1,680 | 8.40 | 4,280 |
| 3.60 | 62 | 5.00 | 620 | 6.40 | 1,780 | 8.60 | 4.600 |
| 3.70 | 80 | 5.10 | 685 | 6.50 | 1,880 | 8.80 | 4,930 |
| 3.80 | 100 | 5.20 | 755 | 6.60 | 1,980 | 9.00 | 5,270 |
| 3.90 | 120 | 5.30 | 830 | 6.70 | 2,090 | 9.20 | 5,630 |
| 4.00 | 150 | 5.40 | 905 | 6.80 | 2,200 | 9.40 | 6,000 |
| 4.10 | 180 | 5.50 | 980 | 6.90 | 2,310 | 9.60 | 6,400 |
| 4.20 | 210 | 5.60 | 1,060 | 7.00 | 2,420 | 9.80 | 6,800 |
| 4.30 | 250 | 5.70 | 1,140 | 7.20 | 2,660 | 10.00 | 7,280 |
| 4.40 | 300 | 5.80 | 1,220 | 7.40 | 2,900 | | |

NOTE.—The above table is based on 22 discharge measurements made during 1903-1905 and is fairly well defined throughout. Above 3.7 feet the table is the same as for 1904.

*Estimated monthly discharge of Stony Creek near Fruto, Cal., for 1905.*

[Drainage area, 760 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 6,700 | 450 | 2,420 | 148,800 | 3.18 | 3.67 |
| February | 7,280 | 685 | 1,471 | 81,700 | 1.94 | 2.02 |
| March | 5,720 | 500 | 2,050 | 126,000 | 2.70 | 3.11 |
| April | 1,490 | 450 | 870 | 51,770 | 1.14 | 1.27 |
| May | 1,680 | 400 | 675 | 41,500 | .888 | 1.02 |
| June | 400 | 80 | 206 | 12,260 | .271 | .302 |
| July | 80 | 14 | 36.5 | 2,244 | .048 | .055 |
| August | 14 | 10 | 12.4 | 762 | .016 | .018 |
| September | 14 | 10 | 13.7 | 815 | .018 | .020 |
| October | 23 | 14 | 16.3 | 1,002 | .021 | .024 |
| November | 62 | 23 | 27.1 | 1,613 | .036 | .040 |
| December | 100 | 62 | 68.1 | 4,187 | .090 | .104 |
| The year | 7,280 | 10 | 656 | 472,700 | .862 | 11.62 |

## FEATHER RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Feather River drains a portion of the western slope of the Sierra Nevada extending east nearly to the Nevada State line, a distance of about 75 miles and north and south for a distance of from 30 to 40 miles.

The greater portion of the watershed is rough and mountainous and has numerous tributaries which drain the slopes of the higher mountains. The formation in the southern and eastern part of the basin is of granite, with a comparatively deep soil covering. There is also a considerable area composed of lava and other volcanic matter in the northern part of the basin. Numerous meadows and valleys also exist, which tend to maintain a steady flow during the dry season. The soil is generally porous and absorbs the moisture readily. The entire watershed is well covered with a growth of brush and timber, much of which is large enough to make lumbering a profitable industry, with the exception of the meadow lands and valleys, which are used for stock ranges and grazing lands. There are numerous large springs, especially in the lava districts, which supply a more or less steady flow throughout the year. These are especially noticeable on North Fork, where there are perennial springs discharging from 50 to 100 second-feet. There is little artificial storage in the drainage area, and the water used for irrigation in the valleys is taken from the natural flow of the streams.

The mean annual precipitation is probably from 40 to 60 inches and is well distributed over the area. It falls largely in the form of snow, but disappears in the early part of the summer.

### FEATHER RIVER AT OROVILLE, CAL.

This station was established January 1, 1902, by S. G. Bennett. It is located at the northeast edge of the town of Oroville, Cal., where Feather River breaks from the foothills on the western slope of the Sierra Nevada into Sacramento Valley. The drainage area is 3,640 square miles.

The current at the station is sluggish at low water and swift at high water. The channel is rough, rocky, and not subject to much change.

Discharge measurements at low and ordinary stages were made by means of a cable and boat 500 feet above the wagon bridge. High-water measurements were made by means of floats. In February, 1905, a cable with car was placed about 1,000 feet above the bridge. The cable has a span of about 400 feet. The initial point of soundings is the eyebolt on the left bank.

The original gage was previously placed by the United States Weather Bureau and used by them for a number of years. Readings were taken on this rod and reported by the Weather Bureau when there was danger of an overflow on the lower Feather and Sacramento rivers. On August 11, 1904, a new gage rod was put in. The zero of this rod was placed 2 feet lower than that of the old Weather Bureau rod to avoid negative readings at low stages of the river. This rod is placed at the wagon bridge on the left bank of the stream and is in four sections. Three of the lower sections are bolted to rock, and the fourth section, for registering the flood stages, is nailed to the bridge pier. In December, 1905, a staff gage was placed at the station 50 feet below the cable on the left bank. During 1905 the gage was read by D. G. Page, readings being taken from the gage at the bridge. The bench marks are as follows: (1) A point on rock marked with white paint, one-half the distance from the low-water gage to the high-water gage on the bridge pier; elevation, 12.25 feet. (2) A point on rock marked with white paint, 35 feet southwest of low-water gage; elevation, 14.86 feet. (3) A circle of white paint on the point of a rock 15 feet upstream from the 70-foot mark on the cable; elevation, 5.05 feet. (4) A point on rock marked with white paint, 4 feet downstream from 15-foot mark on cable; elevation, 27.16 feet. The elevations of bench marks Nos. 1 and 2 refer to the datum of the gage at the bridge; elevations of bench marks Nos. 3 and 4 refer to the datum of the gage established in December, 1905.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Feather River at Oroville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 11 | O. W. Peterson | 281 | 3,424 | 2.22 | 6.45 | 7,618 |
| February 18 | do | 279 | 3,320 | 2.08 | 6.10 | 6,911 |
| May 16 | W. B. Clapp | 281 | 3,728 | 2.28 | 6.65 | 8,509 |
| June 26 | O. W. Peterson | 273 | 2,419 | 1.13 | 2.75 | 2,744 |
| August 1 | Peterson and Lee | 270 | 2,078 | .72 | 1.28 | 1,495 |
| September 2 | C. H. Lee | 268 | 2,005 | .62 | .86 | 1,242 |
| October 7 | Hawley and Lee | 272 | 2,013 | .60 | .90 | 1,210 |
| November 17 | R. S. Hawley | 270 | 1,969 | .62 | .92 | 1,212 |

*Daily gage height, in feet, of Feather River at Oroville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10.0 | 9.5 | 6.9 | 8.3 | 7.15 | 5.4 | 2.1 | 1.3 | 0.95 | 1.0 | 1.0 | 1.4 |
| 2 | 8.3 | 11.3 | 6.9 | 8.05 | 7.05 | 5.25 | 2.1 | 1.25 | .9 | 1.0 | 1.0 | 1.35 |
| 3 | 7.4 | 10.25 | 6.95 | 8.15 | 6.95 | 5.2 | 2.1 | 1.25 | .9 | .95 | 1.0 | 1.2 |
| 4 | 6.65 | 9.05 | 7.5 | 8.1 | 6.85 | 5.2 | 2.05 | 1.2 | .9 | .95 | 1.0 | 1.15 |
| 5 | 5.8 | 8.9 | 7.75 | 8.05 | 6.75 | 5.15 | 2.0 | 1.15 | .9 | .95 | .95 | 1.1 |
| 6 | 5.5 | 8.95 | 7.4 | 8.0 | 6.55 | 5.0 | 2.0 | 1.15 | .95 | 1.0 | .95 | 1.0 |
| 7 | 5.5 | 7.85 | 7.0 | 8.0 | 6.45 | 4.95 | 1.95 | 1.15 | .95 | 1.0 | .95 | 1.0 |
| 8 | 5.1 | 7.4 | 6.8 | 8.05 | 6.35 | 4.95 | 1.9 | 1.1 | 1.0 | 1.0 | .95 | .95 |
| 9 | 4.5 | 6.95 | 6.75 | 8.0 | 6.25 | 4.9 | 1.9 | 1.1 | 1.0 | 1.1 | .9 | .95 |
| 10 | 4.2 | 6.7 | 6.6 | 7.9 | 6.15 | 4.8 | 1.85 | 1.05 | 1.0 | 1.05 | .9 | .95 |
| 11 | 3.4 | 6.5 | 6.7 | 7.8 | 6.1 | 4.7 | 1.8 | 1.05 | 1.0 | 1.05 | .85 | .95 |
| 12 | 3.3 | 6.25 | 7.85 | 7.7 | 6.0 | 4.6 | 1.8 | 1.05 | .95 | 1.0 | .85 | 1.0 |
| 13 | 3.2 | 5.9 | 10.25 | 7.5 | 5.85 | 4.45 | 1.75 | 1.05 | .95 | 1.0 | .85 | 1.0 |
| 14 | 10.15 | 5.6 | 9.95 | 7.5 | 5.9 | 4.2 | 1.75 | 1.0 | .9 | .95 | .85 | 1.1 |
| 15 | 10.25 | 5.4 | 9.45 | 7.5 | 6.15 | 4.1 | 1.7 | 1.0 | .9 | .95 | .9 | 1.2 |
| 16 | 7.65 | 5.4 | 8.8 | 7.4 | 6.45 | 3.9 | 1.7 | 1.0 | .9 | .95 | .9 | 1.15 |
| 17 | 5.6 | 6.35 | 8.4 | 7.4 | 6.6 | 3.8 | 1.65 | 1.05 | .85 | .95 | .9 | [a] 1.15 |
| 18 | 5.5 | 6.35 | 8.9 | 7.45 | 6.5 | 3.7 | 1.65 | 1.05 | .85 | .95 | .9 | [a] 1.15 |
| 19 | 7.4 | 6.1 | 12.5 | 7.55 | 6.45 | 3.6 | 1.6 | 1.05 | .85 | 1.0 | .9 | [a] 1.15 |
| 20 | 6.65 | 7.8 | 11.35 | 7.35 | 6.4 | 3.45 | 1.6 | 1.1 | .9 | 1.0 | 1.0 | [a] 1.15 |
| 21 | 7.35 | 8.25 | 11.35 | 6.95 | 6.4 | 3.2 | 1.6 | 1.1 | .9 | 1.0 | 1.4 | [a] 1.1 |
| 22 | 11.8 | 7.75 | 10.95 | 6.7 | 6.3 | 3.15 | 1.55 | 1.1 | .9 | 1.0 | 1.3 | [a] 1.1 |
| 23 | 11.95 | 7.4 | 10.8 | 6.8 | 6.3 | 3.05 | 1.5 | 1.2 | .95 | 1.0 | 1.3 | [a] 1.1 |
| 24 | 10.5 | 7.3 | 10.7 | 6.95 | 6.3 | 3.0 | 1.5 | 1.2 | .95 | 1.0 | 1.25 | 1.1 |
| 25 | 9.8 | 7.2 | 9.95 | 7.15 | 6.25 | 2.9 | 1.5 | 1.1 | .9 | .95 | 1.2 | 1.15 |
| 26 | 8.65 | 7.1 | 9.3 | 7.3 | 6.2 | 2.8 | 1.45 | 1.0 | .9 | .95 | 1.2 | 1.15 |
| 27 | 7.9 | 7.1 | 9.05 | 7.45 | ....... | 2.6 | 1.45 | 1.0 | .9 | .95 | 1.1 | 1.2 |
| 28 | 7.45 | 7.0 | 9.5 | 7.5 | 6.0 | 2.5 | 1.4 | 1.0 | 1.7 | .95 | 1.1 | 1.2 |
| 29 | 7.1 | ....... | 10.65 | 7.4 | 5.95 | 2.4 | 1.4 | .95 | 1.3 | 1.0 | 1.3 | 1.3 |
| 30 | 6.85 | ....... | 10.05 | 7.3 | 5.85 | 2.3 | 1.35 | 1.0 | 1.0 | 1.0 | 1.4 | 1.35 |
| 31 | 6.75 | ....... | 8.95 | ....... | 5.65 | ....... | 1.35 | 1.0 | ....... | 1.0 | ....... | [a] 1.35 |

[a] Estimated.

*Station rating table for Feather River at Oroville, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 1,230 | 2.70 | 2,590 | 4.40 | 4,570 | 7.20 | 8,640 |
| 1.00 | 1,295 | 2.80 | 2,690 | 4.50 | 4,700 | 7.40 | 9,000 |
| 1.10 | 1,360 | 2.90 | 2,790 | 4.60 | 4,830 | 7.60 | 9,400 |
| 1.20 | 1,430 | 3.00 | 2,900 | 4.70 | 4,960 | 7.80 | 9,800 |
| 1.30 | 1,500 | 3.10 | 3,010 | 4.80 | 5,090 | 8.00 | 10,260 |
| 1.40 | 1,570 | 3.20 | 3,120 | 4.90 | 5,220 | 8.20 | 10,740 |
| 1.50 | 1,640 | 3.30 | 3,230 | 5.00 | 5,350 | 8.40 | 11,260 |
| 1.60 | 1,710 | 3.40 | 3,340 | 5.20 | 5,630 | 8.60 | 11,780 |
| 1.70 | 1,780 | 3.50 | 3,450 | 5.40 | 5,910 | 8.80 | 12,340 |
| 1.80 | 1,850 | 3.60 | 3,570 | 5.60 | 6,190 | 9.00 | 12,900 |
| 1.90 | 1,925 | 3.70 | 3,690 | 5.80 | 6,470 | 9.50 | 14,400 |
| 2.00 | 2,000 | 3.80 | 3,810 | 6.00 | 6,750 | 10.00 | 16,150 |
| 2.10 | 2,075 | 3.90 | 3,930 | 6.20 | 7,050 | 10.50 | 18,100 |
| 2.20 | 2,155 | 4.00 | 4,050 | 6.40 | 7,350 | 11.00 | 20,100 |
| 2.30 | 2,235 | 4.10 | 4,180 | 6.60 | 7,660 | 11.50 | 22,500 |
| 2.40 | 2,315 | 4.20 | 4,310 | 6.80 | 7,980 | 12.00 | 25,100 |
| 2.50 | 2,400 | 4.30 | 4,440 | 7.00 | 8,300 | 12.50 | 28,100 |
| 2.60 | 2,490 | | | | | | |

NOTE.—The above table is based on 21 discharge measurements made during 1904-5. It is well defined between gage heights 0.85 foot and 8 feet. Above gage height 3.5 feet the table is the same as for 1904.

*Estimated monthly discharge of Feather River at Oroville, Cal., for 1905.*

[Drainage area, 3,640 [a] square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 24,800 | 3,120 | 9,860 | 606,300 | 2.71 | 3.12 |
| February | 21,500 | 5,910 | 9,612 | 533,800 | 2.64 | 2.75 |
| March | 28,100 | 7,660 | 13,560 | 833,800 | 3.72 | 4.29 |
| April | 11,000 | 7,820 | 9,403 | 559,500 | 2.58 | 2.88 |
| May | 8,550 | 6,260 | 7,254 | 446,000 | 1.99 | 2.29 |
| June | 5,910 | 2,235 | 4,098 | 243,800 | 1.13 | 1.26 |
| July | 2,075 | 1,535 | 1,790 | 110,100 | .492 | .567 |
| August | 1,500 | 1,262 | 1,354 | 83,250 | .372 | .429 |
| September | 1,780 | 1,200 | 1,273 | 75,750 | .350 | .390 |
| October | 1,360 | 1,262 | 1,286 | 79,070 | .353 | .407 |
| November | 1,570 | 1,200 | 1,321 | 78,610 | .363 | .405 |
| December | 1,570 | 1,262 | 1,385 | 85,160 | .380 | .438 |
| The year | 28,100 | 1,200 | 5,183 | 3,735,000 | 1.42 | 19.23 |

[a] Revised since previous reports.

### MISCELLANEOUS MEASUREMENTS IN FEATHER RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in the Feather River drainage basin during 1905:

*Mohawk Creek near New Mohawk, Cal.*—A measurement was made on this stream on September 10, 1905, just above its junction with Middle Fork of Feather River by H. A. Campbell.

Width, 12.9 feet; area, 16.9 square feet; mean velocity, 1.18 feet per second; discharge, 20 second-feet.

*Middle Fork of Feather River at Mohawk Valley, Cal.*—A measurement was made just above mouth of Mohawk Creek on September 10, 1905, by H. A. Campbell.

Width, 10.0 feet; area, 8.8 square feet; mean velocity, 0.17 foot per second; discharge, 1.5 second-feet.

*Feather River at Prattville, Cal.*—A measurement of this stream was made November 25 at lower end of Big Meadows, 4 miles southeast of Prattville, Cal.

Width, 61 feet; area, 320 square feet; mean velocity, 1.88 feet per second; discharge, 601 second-feet.

*Grizzly Creek near Beckwith, Cal.*—This stream is tributary to Middle Fork of Feather River. A measurement was made December 17 one-half mile above its junction with Middle Fork and about 2½ miles west of the town of Beckwith, Cal.

Width, 4 feet; area, 1.8 square feet; mean velocity, 1.72 feet per second; discharge, 3.1 second-feet.

*Indian Creek near Crescent Mills, Cal.*—This stream is tributary to North Fork of Feather River. A measurement was made December 14 at lower end of Indian Valley, one-half mile below highway bridge on Crescent Mill and Taylorsville road, about 1½ miles below the town of Crescent Mills.

Width, 45 feet; area, 66 square feet; mean velocity 1.15 feet per second; discharge, 76 second-feet.

## YUBA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Yuba River is a tributary of Feather River, which it enters at Marysville, 30 miles above the junction of Feather and Sacramento rivers. The entire drainage area of this river is about 1,327 square miles, of which about 1,220 square miles are above the gaging station at Smartsville. Its extreme length is about 60 miles, and extreme width 56 miles. In the lower stretches of the river, at the location of the present gaging station and in the valley below, the channel has been filled to a considerable depth with débris from hydraulic mining.

The drainage basin is subdivided into 5 small basins, namely: North Fork, with a drainage area of 491.6 square miles; Middle Fork, with a drainage area of 218 square miles; South Fork, with a drainage area of 360 square miles; Deer Creek, with a drainage area of 89.6 square miles, and Dry Creek, with a drainage area of 105.5 square miles. The latter tributary discharges into the main river about 5 miles below the gaging station. The watershed rises gently in rounded and broken mountains, to the crest of the Sierra Nevada, which at the headwaters of the Yuba has a mean elevation of about 8,200 feet, with peaks rising to a height of 9,100 feet. From Mount Lincoln—a peak common to the watersheds of the Yuba, American, and Truckee rivers—to a point about 2½ miles northeast of Mount Weber, the summit of the Sierra Nevada divides the watershed of Yuba River from that of Truckee River, which discharges into Humboldt Basin. Farther north from Mount Weber there is a secondary crest which divides the watersheds of Yuba and Feather rivers, the watershed of the latter stream reaching farther east to a less elevated divide in which the passes are lower than those of the easterly crest.

The western and lower portions of the Yuba drainage basin are composed of slate and kindred rock, very much eroded and merging into the gravel and alluvial deposits of the Sacramento Valley. The upper portions of the basin are composed principally of lavas and granites, all deeply eroded, particularly the lavas. A stratum of serpentine traverses the watershed of the Yuba River in a direction generally parallel with the crest of the Sierras. The North Fork rises in lavas which vary much in composition and hardness, but which generally have a deep soil covering, with timber and brush growth. The Middle Fork rises in similar lavas and granite. The main and tributary streams fall rapidly, and their canyons head well up in the mountains. The sides of these canyons are covered with timber and brush, which, with the deep soil, retain the moisture and feed numerous perennial springs. In the case of the North Fork this is particularly noticeable. The forests of its watersheds make a reliable and constant stream. The mean annual precipitation for the basins of North and Middle forks is about 54 inches. Warm rains on soft snow sometimes give high flood discharge, but snow remains on the higher peaks until midsummer. The headwaters of South Fork lie upon a broad granite surface into which the streams have not cut deeply until the main stream reaches a point 16 miles from the summit, where it drops rapidly into a deeply eroded canyon. This part of the basin has a precipitation annually of about 60 inches. The entire drainage area of the Yuba contains nearly 100 small glacial lakes.

### YUBA RIVER NEAR SMARTSVILLE, CAL.

This station was established June 2, 1903, by W. H. Stearns. It is located at what is called "The Narrows," 1 mile from Smartsville, Cal., 18 miles from the Southern Pacific Railroad station at Wheatland, Cal., and 20 miles from Marysville, Cal.

The channel is straight for 200 feet above and 300 feet below the station, and the current is swift at all stages. In the 150 feet above the cable the stream has a fall of 0.2 foot and of 0.9 foot in the 200 feet below. Both banks are high and rocky and are not subject to overflow. The banks widen out considerably just below the station. The bed of the stream is composed of gravel and sand—tailings from hydraulic mining—and is constantly shifting. After the rains of 1904 it was found that the bed of the stream had been lowered for an average depth of 2 feet.

Discharge measurements are made from a car and cable. One auxiliary cable is stretched parallel to and 100 feet upstream from the main cable, and a second one is located 150 feet below the station cable for float measurements. The initial point for soundings is on the left bank at the eyebolt to which the cable is fastened. Frequent discharge measurements are made on account of continual changes of the river bed. These changes, however, do not materially affect discharge measurements for the same gage height.

The gage is in two sections. The lower one is bolted to the rock wall on the left bank of the river and the upper one to the right bank. During 1905 the gage was read once each day by J. R. McKeel. Bench marks were established as follows: (1) A point on a rock marked with white paint, 12 feet upstream and about 15 feet to the left of the right eyebolt; elevation, 39.34 feet. (2) A bolt in shelf of rock marked with white paint, 12 feet from high-water gage on right bank; elevation, 13.75 feet. (3) A bolt in the face of rock 20 feet upstream from the cable on right bank; elevation, 16.60 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134, United States Geological Survey.

*Discharge measurements of Yuba River near Smartsville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 20 | J. R. McKeel | 180 | 688 | 5.09 | 6.70 | 3,500 |
| February 12 | do | 175 | 671 | 4.69 | 6.30 | 3,147 |
| February 13 | O. W. Peterson | 178 | 665 | 4.39 | 6.25 | 2,920 |
| February 26 | J. R. McKeel | 180 | 936 | 5.76 | 7.00 | 5,397 |
| March 5 | do | 179 | 836 | 5.40 | 6.60 | 4,512 |
| March 15 | do | 180 | 982 | 6.02 | 6.90 | 5,914 |
| April 8 | do | 170 | 1,060 | 6.56 | 7.00 | 6,959 |
| April 24 | do | 170 | 968 | 6.64 | 6.30 | 6,423 |
| May 4 | do | 180 | 868 | 6.01 | 5.80 | 5,221 |
| May 13 | do | 180 | 861 | 5.94 | 5.50 | 5,132 |
| May 28 | do | 183 | 883 | 6.31 | 5.75 | 5,570 |
| June 4 | do | 180 | 732 | 5.40 | 5.00 | 3,955 |
| June 16 | do | 180 | 652 | 5.09 | 4.50 | 3,318 |
| July 7 | do | 155 | 286 | 3.58 | 2.40 | 1,025 |
| July 20 | do | 74 | 165 | 4.22 | 2.00 | 697 |
| July 29 | do | 73 | 158 | 4.01 | 1.60 | 634 |
| July 31 | O. W. Peterson, C. H. Lee | 76 | 137 | 3.38 | 1.64 | 463 |
| August 7 | J. R. McKeel | 68 | 137 | 3.83 | 1.50 | 525 |
| August 15 | do | 62 | 126 | 3.78 | 1.40 | 476 |
| August 21 | do | 68 | 140 | 3.80 | 1.50 | 532 |
| August 28 | do | 62 | 120 | 3.68 | 1.30 | 442 |
| September 5 | do | 62 | 120 | 3.66 | 1.30 | 439 |
| September 25 | do | 57 | 113 | 3.56 | 1.20 | 402 |
| October 8 | Hawley and Lee | 74 | 115 | 3.43 | 1.45 | 395 |
| October 20 | J. R. McKeel | 66 | 126 | 3.62 | 1.40 | 456 |
| October 30 | do | 66 | 125 | 3.55 | 1.35 | 444 |
| November 9 | do | 63 | 121 | 3.48 | 1.30 | 420 |
| November 16 | do | 63 | 117 | 3.44 | 1.20 | 403 |
| November 23 | do | 63 | 123 | 3.56 | 1.35 | 438 |
| November 30 | do | 150 | 224 | 3.70 | 2.20 | 830 |
| December 6 | do | 70 | 140 | 3.80 | 1.60 | 533 |
| December 13 | do | 68 | 133 | 3.65 | 1.50 | 486 |
| December 29 | do | 84 | 167 | 3.96 | 1.90 | 661 |

*Daily gage height, in feet, of Yuba River near Smartsville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.0 | 7.5 | 6.7 | 7.0 | 6.5 | 5.5 | 2.7 | 1.6 | 1.3 | 1.4 | 1.4 | 2.0 |
| 2 | 8.4 | 9.4 | 6.7 | 7.0 | 6.3 | 5.2 | 2.7 | 1.6 | 1.3 | 1.4 | 1.4 | 1.7 |
| 3 | 7.6 | 8.5 | 6.6 | 7.1 | 6.1 | 5.1 | 2.6 | 1.6 | [a]1.3 | 1.4 | 1.4 | 1.7 |
| 4 | 7.2 | 7.9 | 6.7 | 7.1 | 5.8 | 5.0 | [a]2.5 | 1.6 | 1.3 | 1.4 | 1.4 | 1.7 |
| 5 | 6.9 | 8.5 | 6.6 | 7.0 | 5.7 | 4.8 | 2.5 | 1.6 | 1.3 | 1.4 | [a]1.4 | 1.6 |
| 6 | 6.8 | 7.6 | 6.6 | 7.1 | 5.7 | 4.9 | 2.4 | [a]1.6 | 1.3 | 1.3 | 1.4 | 1.6 |
| 7 | 6.4 | 7.2 | 6.5 | 7.3 | 5.6 | 5.0 | 2.4 | 1.5 | 1.3 | 1.3 | 1.4 | 1.6 |
| 8 | 6.4 | 7.0 | 6.5 | 7.0 | 6.0 | 4.9 | 2.3 | 1.5 | 1.3 | 1.4 | 1.3 | 1.6 |
| 9 | 6.3 | 6.8 | 6.4 | 6.9 | 6.2 | 4.9 | 2.3 | 1.5 | 1.3 | [a]1.4 | 1.3 | 1.5 |
| 10 | 6.2 | 6.6 | 6.4 | 6.9 | 5.7 | 4.9 | 2.2 | 1.5 | [a]1.3 | 1.4 | 1.3 | [a]1.5 |
| 11 | 6.1 | 6.6 | 6.3 | 6.5 | 5.7 | 5.2 | 2.2 | 1.5 | 1.3 | 1.4 | 1.3 | 1.5 |
| 12 | 6.1 | 6.3 | 6.4 | 6.3 | 5.5 | 5.0 | 2.2 | 1.5 | 1.2 | 1.4 | [a]1.3 | 1.5 |
| 13 | 6.1 | 6.2 | 7.3 | 6.3 | 5.5 | 5.0 | 2.1 | [a]1.5 | 1.2 | 1.4 | 1.3 | 1.5 |
| 14 | 8.2 | 6.1 | 7.7 | 6.2 | [a]5.8 | 4.7 | 2.1 | 1.5 | 1.2 | 1.4 | 1.3 | 1.5 |
| 15 | 7.7 | 6.1 | 6.9 | 6.2 | 6.1 | 4.7 | 2.1 | 1.4 | 1.2 | [a]1.3 | 1.3 | 1.5 |
| 16 | 7.3 | 6.0 | 6.8 | 6.4 | 6.9 | 4.5 | 2.1 | 1.4 | 1.2 | 1.3 | 1.2 | 1.6 |
| 17 | 6.9 | 7.0 | 6.6 | 6.0 | 7.0 | 4.5 | 2.0 | 1.4 | [a]1.2 | 1.3 | 1.2 | 1.6 |
| 18 | 6.3 | 7.0 | 7.3 | 7.2 | 6.9 | 4.3 | 2.0 | 1.4 | 1.2 | 1.4 | 1.2 | 2.0 |
| 19 | [a]6.5 | 6.9 | 11.3 | 6.3 | 6.9 | 4.2 | 2.0 | 1.4 | [a]1.2 | 1.4 | [a]1.4 | 2.0 |
| 20 | 6.7 | 8.5 | 8.8 | 6.0 | 6.8 | 4.0 | 2.0 | [a]1.4 | 1.2 | 1.4 | 1.5 | 2.4 |
| 21 | 7.5 | 7.4 | 9.4 | 6.0 | 7.0 | 3.8 | 1.9 | 1.4 | 1.2 | 1.4 | 1.6 | 2.0 |
| 22 | 10.4 | 7.1 | 8.5 | 6.0 | 6.3 | 3.6 | 1.9 | 1.5 | 1.2 | [a]1.4 | 1.4 | 1.8 |
| 23 | 10.0 | 6.9 | 7.9 | 6.1 | 6.2 | 3.4 | 1.8 | 1.4 | 1.2 | 1.4 | 1.4 | 1.6 |
| 24 | 8.9 | 6.8 | 8.4 | 6.3 | 6.0 | 3.3 | 1.8 | 1.4 | [a]1.2 | 1.4 | 1.3 | 1.6 |
| 25 | 8.2 | 6.9 | 8.0 | 6.6 | 6.2 | 3.2 | 1.8 | 1.4 | 1.2 | 1.4 | 1.4 | 1.6 |
| 26 | 7.8 | 7.0 | 8.1 | 7.0 | 6.5 | 3.1 | 1.7 | 1.4 | 1.2 | 1.5 | [a]1.6 | 1.6 |
| 27 | 7.4 | 6.9 | 8.0 | 7.4 | 5.8 | 3.0 | 1.7 | [a]1.4 | 1.5 | 1.4 | 1.8 | 1.6 |
| 28 | 7.1 | 6.8 | 7.5 | 7.1 | 5.7 | 2.9 | 1.7 | 1.3 | 1.5 | [a]1.4 | 1.6 | 1.8 |
| 29 | 6.9 | ....... | 8.4 | 7.0 | 5.6 | 2.8 | 1.6 | 1.3 | 1.4 | [a]1.4 | 1.8 | 1.9 |
| 30 | 6.8 | ....... | 8.0 | 7.1 | 5.5 | 2.8 | 1.6 | 1.3 | 1.4 | 1.4 | 2.2 | 1.8 |
| 31 | 6.7 | ....... | 7.3 | ....... | 5.5 | ....... | 1.6 | 1.3 | ....... | 1.4 | ....... | 1.8 |

[a] Gage heights estimated.

*Daily discharge, in second-feet, of Yuba River near Smartsville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8,500 | 5,200 | 4,750 | 6,730 | 6,845 | 4,920 | 1,235 | 515 | 435 | 455 | 455 | 710 |
| 2 | 7,000 | 10,050 | 4,750 | 6,730 | 6,440 | 4,395 | 1,235 | 515 | 435 | 455 | 455 | 555 |
| 3 | 5,120 | 7,650 | 4,550 | 7,060 | 6,045 | 4,225 | 1,145 | 515 | 435 | 455 | 455 | 555 |
| 4 | 4,300 | 6,150 | 4,750 | 7,060 | 5,470 | 4,060 | 1,060 | 515 | 435 | 455 | 455 | 555 |
| 5 | 3,750 | 7,680 | 4,512 | 6,850 | 5,285 | 3,745 | 1,060 | 515 | 435 | 455 | 455 | 515 |
| 6 | 3,570 | 5,500 | 4,512 | 7,160 | 5,285 | 3,900 | 980 | 515 | 435 | 435 | 455 | 515 |
| 7 | 2,920 | 4,670 | 4,460 | 7,600 | 5,100 | 4,060 | 980 | 480 | 435 | 435 | 455 | 515 |
| 8 | 2,920 | 4,310 | 4,460 | 6,960 | 5,850 | 3,900 | 905 | 480 | 435 | 455 | 435 | 515 |
| 9 | 2,770 | 3,950 | 4,400 | 6,750 | 6,240 | 3,900 | 905 | 480 | 435 | 455 | 435 | 480 |
| 10 | 2,630 | 3,600 | 4,650 | 6,900 | 5,285 | 3,900 | 835 | 480 | 435 | 455 | 435 | 480 |
| 11 | 2,510 | 3,650 | 4,400 | 6,160 | 5,285 | 4,395 | 835 | 480 | 435 | 455 | 435 | 480 |
| 12 | 2,510 | 3,147 | 4,700 | 5,770 | 4,920 | 4,060 | 835 | 480 | 415 | 455 | 435 | 480 |
| 13 | 2,510 | 2,920 | 6,700 | 5,900 | 4,920 | 4,060 | 770 | 480 | 415 | 455 | 435 | 480 |
| 14 | 6,500 | 2,780 | 7,850 | 5,700 | 5,470 | 3,595 | 770 | 480 | 415 | 455 | 435 | 480 |
| 15 | 5,350 | 2,780 | 5,914 | 5,800 | 6,045 | 3,595 | 770 | 455 | 415 | 435 | 435 | 480 |
| 16 | 4,500 | 2,750 | 5,710 | 6,190 | 7,700 | 3,300 | 770 | 455 | 415 | 435 | 415 | 515 |
| 17 | 3,850 | 4,550 | 5,420 | 5,520 | 7,920 | 3,300 | 710 | 455 | 415 | 435 | 415 | 515 |
| 18 | 2,850 | 4,650 | 6,800 | 8,000 | 7,700 | 3,015 | 710 | 455 | 415 | 455 | 415 | 710 |
| 19 | 3,160 | 4,500 | 17,400 | 6,200 | 7,700 | 2,880 | 710 | 455 | 415 | 455 | 435 | 710 |
| 20 | 3,500 | 8,400 | 10,320 | 5,620 | 7,480 | 2,620 | 710 | 455 | 415 | 455 | 480 | 980 |
| 21 | 5,040 | 5,800 | 11,800 | 5,720 | 7,920 | 2,375 | 650 | 455 | 415 | 455 | 515 | 710 |
| 22 | 12,850 | 5,250 | 9,700 | 5,720 | 6,440 | 2,145 | 650 | 480 | 415 | 455 | 455 | 600 |
| 23 | 11,550 | 4,920 | 8,350 | 6,030 | 6,240 | 1,930 | 600 | 455 | 415 | 455 | 455 | 515 |
| 24 | 8,520 | 4,800 | 9,500 | 6,420 | 5,850 | 1,825 | 600 | 455 | 415 | 455 | 435 | 515 |
| 25 | 6,750 | 5,060 | 8,700 | 7,055 | 6,240 | 1,720 | 600 | 455 | 415 | 455 | 455 | 515 |
| 26 | 5,800 | 5,397 | 8,900 | 7,920 | 6,845 | 1,620 | 555 | 455 | 415 | 480 | 515 | 515 |
| 27 | 4,950 | 5,150 | 8,700 | 8,800 | 5,470 | 1,520 | 555 | 455 | 480 | 455 | 600 | 515 |
| 28 | 4,350 | 4,950 | 7,800 | 8,140 | 5,285 | 1,420 | 555 | 435 | 480 | 455 | 515 | 600 |
| 29 | 4,000 | ........ | 9,720 | 7,920 | 5,100 | 1,325 | 515 | 435 | 455 | 455 | 600 | 650 |
| 30 | 3,820 | ........ | 8,800 | 8,140 | 4,920 | 1,325 | 515 | 435 | 455 | 455 | 835 | 600 |
| 31 | 3,650 | ........ | 7,350 | ........ | 4,920 | ........ | 515 | 435 | ...... | 455 | ...... | 600 |

NOTE.—January 1 to April 24 the daily discharge was obtained indirectly. From April 25 to December 31 the daily discharge was obtained from a rating table based on measurements subsequent to April 24.

*Estimated monthly discharge of Yuba River near Smartsville, Cal., for 1905.*

[Drainage area, 1,220 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 12,850 | 2,510 | 4,903 | 301,500 | 4.02 | 4.64 |
| February | 10,050 | 2,750 | 5,008 | 278,100 | 4.10 | 4.27 |
| March | 17,400 | 4,400 | 7,107 | 437,000 | 5.83 | 6.72 |
| April | 8,800 | 5,520 | 6,751 | 401,700 | 5.53 | 6.17 |
| May | 7,920 | 4,920 | 6,071 | 373,300 | 4.98 | 5.74 |
| June | 4,920 | 1,325 | 3,101 | 184,500 | 2.54 | 2.83 |
| July | 1,235 | 515 | 782 | 48,080 | .641 | .739 |
| August | 515 | 435 | 471 | 28,960 | .386 | .445 |
| September | 480 | 415 | 429 | 25,530 | .352 | .393 |
| October | 480 | 435 | 453 | 27,850 | .371 | .428 |
| November | 835 | 415 | 474 | 28,200 | .389 | .434 |
| December | 980 | 480 | 566 | 34,800 | .464 | .535 |
| The year | 12,850 | 415 | 3,010 | 2,170,000 | 2.47 | 33.34 |

## MISCELLANEOUS MEASUREMENTS, YUBA RIVER DRAINAGE BASIN.

*Bay Counties Power Company flume near Nevada City, Cal.*—A measurement was made in the flume opposite Purdon bridge over the South Fork of Yuba River on September 3, 1905, by H. A. Campbell.

Width, 6 feet; area, 13.5 square feet; mean velocity, 5.11 feet per second; discharge, 69 second-feet.

*Middle Fork of Yuba River near Nevada City, Cal.*—A measurement was made one-half mile upstream from Freeman's bridge and about 3 miles north of Nevada City on September 4, 1905, by H. A. Campbell.

Width, 22 feet; area, 31 square feet; mean velocity, 2.06 feet per second; discharge, 64 second-feet.

*North Fork of Yuba River near Goodyears bar, Cal.*—A measurement was made on this stream September 5, 1905, from the downstream side of the wagon bridge at Goodyears bar by H. A. Campbell.

Width, 44 feet; area, 96 square feet; mean velocity, 1.54 feet per second; discharge, 149 second-feet.

*North Fork of North Fork of Yuba River near Downieville, Cal.*—This stream enters the North Fork of Yuba River at Downieville, Cal. A measurement was made 1½ miles north of Downieville and 100 yards above its junction with Middle Fork of North Fork on September 6, 1905, by H. A. Campbell.

Width, 10 feet; area, 18.5 square feet; mean velocity, 0.36 foot per second; discharge, 6.7 second-feet.

A measurement was made 30 yards below junction of Middle Fork of North Fork of Yuba River, about 1½ miles north of Downieville, Cal., on September 6, 1905, by H. A. Campbell.

Width, 26 feet; area, 37 square feet; mean velocity, 0.73 foot per second; discharge, 27 second-feet.

*Wheeler flume near Downieville, Cal.*—This flume takes water from the East Fork of the North Fork of Yuba River. A measurement was made on September 6, 1905, at the headgate three-fourths mile north of Downieville by H. A. Campbell.

Width, 3.1 feet; area, 2.3 square feet; mean velocity, 1.91 feet per second; discharge, 4.4 second-feet.

*Davis ditch near Downieville, Cal.*—This ditch is taken out of East Fork of North Fork of Yuba River about a mile above Downieville. A measurement was made one-half mile below the head-gate on September 6, 1905, by H. A. Campbell.

Width, 3.0 feet; area, 1.9 square feet; mean velocity, 1.47 feet per second; discharge, 2.8 second-feet.

*East Fork of North Fork of Yuba River at Downieville, Cal.*—A measurement was made on September 6, 1905, 10 yards above its junction with North Fork of North Fork of Yuba River at Downieville by H. A. Campbell.

Width, 22 feet; area, 29 square feet; mean velocity, 0.59 foot per second; discharge, 17 second-feet.

*North Fork of North Fork of Yuba River at Downieville, Cal.*—A measurement was made on September 6, 1905, on this stream 10 yards above its junction with North Fork of Yuba River by H. A. Campbell.

Width, 28 feet; area, 52 square feet; mean velocity, 0.77 foot per second; discharge, 40 second-feet.

*North Fork of Yuba River at Downieville, Cal.*—A measurement was made from the upstream side of the wagon bridge at Downieville on September 6, 1905, by H. A. Campbell.

Width, 40 feet; area, 184 square feet; mean velocity, 0.76 foot per second; discharge, 139 second-feet.

*South Fork of North Fork of Yuba River near Sierra City, Cal.*—A measurement was made on September 7, 1905, by H. A. Campbell, about one-third of a mile above its junction with the North Fork of the North Fork and about 1¼ miles east of Sierra City.

Width, 2.7 feet; area, 2.5 square feet; mean velocity, 0.68 foot per second; discharge, 1.7 second-feet.

*Mining company's flume near Sierra City, Cal.*—A measurement was made on September 7, 1905, by H. A. Campbell, about 1 mile below heading.

Width, 2.5 feet; area, 2.2 square feet; mean velocity, 4.50 feet per second; discharge, 9.9 second-feet.

*North Fork of North Fork of Yuba River near Sierra City, Cal.*—A measurement was made on September 7, 1905, by H. A. Campbell, about one-half mile above its junction with the South Fork of the North Fork and about 1 mile east of Sierra City.

Width, 25 feet; area, 41 square feet; mean velocity, 0.56 foot per second; discharge, 23 second-feet.

## BEAR RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Bear River drains an area of 287 square miles between the Yuba and American rivers. Its headwaters do not reach back to the crest of the range so that it seldom receives precipitation in the form of lasting snow. It is torrential in character, having no forested areas except in its upper portion. The rainfall records kept by the Central Pacific from Auburn to Emigrant Gap are indicative of the precipitiation in the southern part of its basin. A 28-year record at Grass Valley in the northern portion of its watershed gives a mean of 49.41 inches.

### BEAR RIVER ABOVE WHEATLAND, CAL.

This station was established by O. W. Peterson on October 8, 1904. It is located about 800 feet below McCourtney Crossing and 8 miles above Wheatland.

The channel is straight for 350 feet both above and below the station. At ordinary stages the velocity is moderate. Neither bank is subject to overflow. The bed of the stream is composed of gravel and is not subject to any material change.

Discharge measurements are made from a car and cable. An auxiliary cable is located 150 feet downstream and parallel to the large one, so that float measurements can be made at very high water. The white-oak tree to which the right end of the cable is fastened is the initial point for soundings.

The gage rods are 300 feet above the station, on the left bank of the river. Two of the sections are bolted to the rock and the upper section is nailed to a tree. During 1905 the gage was read once each day by Hermann Ernestus. A standard United States Geological Survey bench mark is sulphured in a hole drilled in the rock between the two upper sections of the gage; elevation, 12.26 feet above the datum of the gage.

A description of this station with gage height and discharge data is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Bear River above Wheatland, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 8 | F. R. S. Buttemer | 142 | 225 | 4.21 | 5.10 | 948 |
| February 13 | do | 140 | 165 | 3.62 | 4.57 | 596 |
| February 19 | do | 139 | 172 | 3.66 | 4.66 | 629 |
| February 24 | do | 139 | 151 | 3.50 | 4.50 | 528 |
| June 27 | O. W. Peterson | 42 | 47 | 1.89 | 3.42 | 89 |
| July 30 | Peterson and Lee | 27 | 39 | .95 | 3.10 | 37 |
| September 3 | C. H. Lee | 31 | 44 | 1.43 | 3.24 | 63 |
| October 10 | Hawley and Lee | 26 | 20 | 2.15 | 3.00 | 43 |

*Daily gage height, in feet, of Bear River above Wheatland, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 5.6 | 4.3 | [a] 5.45 | [a] 4.1 | [a] 4.1 | 3.2 | 3.1 | 3.2 | 3.1 | 3.1 | 3.4 |
| 2 | 4.8 | 7.0 | 4.2 | 5.3 | [a] 4.2 | [a] 4.1 | 3.2 | 3.1 | 3.2 | 3.1 | 3.0 | 3.3 |
| 3 | 4.3 | 4.9 | 4.2 | 5.0 | 4.5 | [a] 4.1 | 3.2 | 3.1 | 3.2 | 3.1 | 3.0 | 3.2 |
| 4 | 4.2 | 6.7 | 4.2 | 4.9 | 4.2 | [a] 4.1 | 3.2 | 3.1 | 3.2 | 3.1 | 3.0 | 3.2 |
| 5 | 4.2 | 7.0 | 4.2 | 4.8 | [a] 4.4 | [a] 4.1 | 3.2 | 3.1 | 3.4 | 3.1 | 3.0 | 3.2 |
| 6 | 4.1 | 5.5 | 4.2 | 4.7 | [a] 4.5 | [a] 4.0 | 3.2 | 3.1 | 3.2 | 3.1 | 3.0 | 3.1 |
| 7 | 4.0 | 5.1 | 4.2 | 4.6 | 4.6 | [a] 4.0 | 3.1 | 3.1 | 3.2 | 3.1 | 3.0 | 3.1 |
| 8 | 3.9 | 5.2 | 4.1 | 4.5 | [a] 4.7 | [a] 3.8 | 3.1 | 3.1 | 3.2 | 3.1 | 3.0 | 3.1 |
| 9 | 4.4 | 5.0 | 4.0 | 4.4 | 4.8 | [a] 3.8 | 3.1 | 3.1 | 3.2 | 3.1 | 3.0 | 3.1 |
| 10 | 4.2 | 4.8 | 4.0 | 4.4 | [a] 4.7 | [a] 3.8 | 3.1 | 3.1 | 3.1 | 3.1 | 3.0 | 3.0 |
| 11 | 4.0 | 4.9 | 4.0 | 4.4 | [a] 4.7 | [a] 3.8 | 3.1 | 3.1 | 3.1 | 3.1 | 3.0 | 3.0 |
| 12 | 3.9 | 4.6 | 4.2 | 4.4 | [a] 4.7 | [a] 3.8 | 3.1 | 3.1 | 3.1 | 3.1 | 3.0 | 3.0 |
| 13 | 3.8 | 4.5 | 4.7 | 4.3 | [a] 4.7 | [a] 3.8 | 3.1 | 3.35 | 3.1 | 3.1 | 2.9 | 3.0 |
| 14 | 5.0 | 4.4 | 4.6 | 4.3 | [a] 4.7 | [a] 3.8 | 3.1 | 3.1 | 3.1 | 3.1 | 2.9 | 3.0 |
| 15 | 4.5 | 4.3 | 4.4 | 4.3 | [a] 5.1 | [a] 3.8 | 3.2 | 3.4 | 3.1 | 3.1 | 2.9 | 3.0 |
| 16 | 4.8 | 4.7 | 4.4 | 4.5 | [a] 5.5 | [a] 3.6 | 3.1 | 3.1 | 3.1 | 3.1 | 2.9 | 3.1 |
| 17 | 4.4 | 5.0 | 4.4 | 4.4 | [a] 5.5 | [a] 3.6 | 3.1 | 3.1 | 3.1 | 3.1 | 2.9 | 3.0 |
| 18 | 4.3 | 4.8 | 4.9 | 4.9 | [a] 5.2 | [a] 3.6 | 3.2 | 3.1 | 3.0 | 3.1 | 2.9 | 3.0 |
| 19 | 4.9 | 4.7 | 10.5 | 4.9 | [a] 5.0 | [a] 3.6 | 3.1 | 3.1 | 3.0 | 3.1 | 2.9 | 3.2 |
| 20 | 4.6 | 5.1 | 6.8 | 4.6 | [a] 5.0 | [a] 3.6 | 3.1 | 3.1 | 3.0 | 3.1 | 3.0 | 3.4 |
| 21 | 6.5 | 4.9 | 6.8 | 4.7 | [a] 4.8 | [a] 3.6 | 3.1 | 3.1 | 3.0 | 3.1 | 3.1 | 3.3 |
| 22 | 8.5 | 4.7 | 5.9 | 4.7 | [a] 4.6 | [a] 3.6 | 3.1 | 3.1 | 3.0 | 3.1 | 3.0 | 3.2 |
| 23 | 7.5 | 4.6 | 5.4 | 4.5 | [a] 4.5 | [a] 3.5 | 3.1 | 3.1 | 3.0 | 3.0 | 3.0 | 3.1 |
| 24 | 5.7 | 4.5 | 5.9 | 4.4 | [a] 4.4 | [a] 3.5 | 3.1 | 3.1 | 3.0 | 3.1 | 3.0 | 3.0 |
| 25 | 5.2 | 4.5 | 5.3 | 4.3 | [a] 4.3 | [a] 3.5 | 3.1 | 3.1 | 3.2 | 3.1 | 3.0 | 3.0 |
| 26 | 5.0 | 4.4 | 5.5 | 4.2 | [a] 4.3 | [a] 3.5 | 3.1 | 3.1 | 3.1 | 3.1 | 3.0 | 3.0 |
| 27 | 5.8 | 4.4 | 5.7 | [a] 4.2 | [a] 4.2 | 3.5 | 3.1 | 3.1 | 3.1 | 3.0 | 3.35 | 3.0 |
| 28 | 5.6 | 4.3 | 5.4 | [a] 4.2 | [a] 4.2 | 3.5 | 3.1 | 3.1 | 3.1 | 3.1 | 3.2 | 3.0 |
| 29 | 5.5 | ....... | 7.0 | [a] 4.1 | [a] 4.2 | 3.4 | 3.1 | 3.1 | 3.2 | 3.1 | 3.2 | 3.4 |
| 30 | 5.5 | ....... | 6.2 | 4.1 | [a] 4.2 | 3.3 | 3.1 | 3.3 | 3.1 | 3.1 | 3.5 | 3.2 |
| 31 | 5.8 | ....... | 5.6 | ....... | [a] 4.2 | ....... | 3.1 | 3.2 | ....... | 3.1 | ....... | 3.3 |

[a] Estimated.

*Station rating table for Bear River above Wheatland, Cal., from October 9, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.90 | 10 | 4.10 | 328 | 5.30 | 1,105 | 7.00 | 3,250 |
| 3.00 | 20 | 4.20 | 375 | 5.40 | 1,200 | 7.20 | 3,575 |
| 3.10 | 33 | 4.30 | 425 | 5.50 | 1,300 | 7.40 | 3,910 |
| 3.20 | 49 | 4.40 | 475 | 5.60 | 1,405 | 7.60 | 4,265 |
| 3.30 | 69 | 4.50 | 530 | 5.70 | 1,515 | 7.80 | 4,635 |
| 3.40 | 92 | 4.60 | 585 | 5.80 | 1,625 | 8.00 | 5,020 |
| 3.50 | 118 | 4.70 | 645 | 5.90 | 1,740 | 8.20 | 5,410 |
| 3.60 | 146 | 4.80 | 710 | 6.00 | 1,860 | 8.40 | 5,810 |
| 3.70 | 177 | 4.90 | 780 | 6.20 | 2,105 | 8.60 | 6,220 |
| 3.80 | 210 | 5.00 | 855 | 6.40 | 2,365 | 8.80 | 6,640 |
| 3.90 | 246 | 5.10 | 930 | 6.60 | 2,640 | 9.00 | 7,060 |
| 4.00 | 285 | 5.20 | 1,015 | 6.80 | 2,935 | | |

NOTE.—The above table is based on 11 discharge measurements made during 1904–5. It is well defined between gage heights 3.1 feet and 5.1 feet. Above 6 feet the table is a rough approximation.

*Estimated monthly discharge of Bear River above Wheatland, Cal., for 1904 and 1905.*

[Drainage area, 263 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| 1904. | | | | | | |
| October 9–31 | 7,060 | 92 | 559 | 25,500 | 2.13 | 1.82 |
| November | 1,300 | 92 | 223 | 13,270 | .848 | .946 |
| December | 6,640 | 118 | 504 | 30,990 | 1.92 | 2.21 |
| 1905. | | | | | | |
| January | 6,015 | 210 | 1,058 | 65,060 | 4.02 | 4.64 |
| February | 3,250 | 425 | 975 | 54,150 | 3.71 | 3.86 |
| March | 10,210 | 285 | 1,300 | 79,930 | 4.94 | 5.70 |
| April | 1,250 | 328 | 576 | 34,270 | 2.19 | 2.44 |
| May | 1,300 | 328 | 615 | 37,820 | 2.34 | 2.70 |
| June | 328 | 69 | 193 | 11,480 | .734 | .819 |
| July | 49 | 33 | 37.1 | 2,281 | .141 | .163 |
| August | 92 | 33 | 38.1 | 2,343 | .145 | .167 |
| September | 92 | 20 | 37.3 | 2,220 | .142 | .158 |
| October | 33 | 20 | 32.2 | 1,980 | .122 | .141 |
| November | 118 | 10 | 23.8 | 1,416 | .090 | .100 |
| December | 92 | 20 | 39.8 | 2,447 | .151 | .174 |
| The year | 10,210 | 10 | 410 | 295,400 | 1.56 | 21.06 |

NOTE.—Discharge estimated for missing gage heights.

### MISCELLANEOUS MEASUREMENTS IN BEAR RIVER DRAINAGE BASIN.

*South Yuba Mining Company's ditch near Colfax, Cal.*—This ditch is taken out of Bear River 2½ miles east of Colfax. A measurement was made September 1, 1905, one-eighth of a mile below this heading in flume, by H. A. Campbell.

Width, 6.0 feet; area, 11.8 square feet; mean velocity, 2.54 feet per second; discharge, 30 second-feet.

*Bear River near Colfax, Cal.*—A measurement was made September 1, 1905, one-eighth of a mile below intake of the South Yuba Mining Company's canal and 2½ miles northeast of Colfax, by H. A. Campbell.

Width, 29 feet; area, 17.8 square feet; mean velocity, 1.45 feet per second; discharge, 26 second-feet.

*Green Horn River near Colfax, Cal.*—A measurement was made 75 yards above the junction of Big Horn and Bear rivers and about 3½ miles north of Colfax on September 1, 1905, by H. A. Campbell.

Width, 10 feet; area, 6.0 square feet; mean velocity, 1.13 feet per second; discharge, 6.8 second-feet.

*Bear River near Colfax, Cal.*—A measurement was made on this stream on September 1, 1905, about 100 yards above mouth of Green Horn River and 3½ miles north of Colfax.

Width, 24 feet; area, 21 square feet; mean velocity, 2.05 feet per second; discharge, 43 second-feet.

## CACHE CREEK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Cache Creek drains that portion of the eastern slope of the Coast Range directly north from the Puta Creek basin. This basin is long and narrow, extending from northwest to southeast; it has numerous tributaries, of which North Fork is the largest. Most of these tributaries are torrential in their character, but the flow of the main stream is regulated largely by its discharge from Clear Lake, which is fed by numerous creeks having their source in the higher portion of the drainage basin. The lake covers an area of 65 square miles, and has a drainage area of 417 square miles. The streams which enter Cache Creek below Clear Lake are practically dry during the summer months. There are large cultivated areas on the west side of Clear Lake, a greater portion of which is meadow land used for stock raising. There are two gaging stations located on this stream—one at Lower Lake directly at the point where the stream discharges from the lake and one at Yolo a short distance below where it emerges from the foothills. There are numerous diversions above the gaging station at Yolo which take practically the entire flow during the summer months. This water is used for irrigation in the vicinity of Woodland and Yolo, where the soil is rich and deep and susceptible of the highest state of cultivation.

### CLEAR LAKE AT LAKEPORT, CAL.

This station was established in January, 1901. It embraces evaporation for both lake and land. The lake pan is held in place by a triangular raft placed in a protected arm of the lake and anchored in such a manner that it has a clear swing, adjusting itself to the wind so one of its angles will cut the water. The pan is submerged to within an inch or so of the water surface. The land pan is located in a clear open space and set in the ground so that its top is flush with the ground surface, it being protected by a small wire fence that it may not be disturbed. These pans are the regulation type, as referred to in Circular No. 4 of instructions for observing evaporation. The record of this station from January, 1901, to December, 1904, was published in Water-Supply Paper No. 134. The observer is Mr. D. C. Rumsey, at Lakeport, Cal.

*Evaporation record of Clear Lake at Lakeport, Cal., 1905.*

| Month. | Evaporation in inches. | | Month. | Evaporation in inches. | |
|---|---|---|---|---|---|
| | Lake. | Land. | | Lake. | Land. |
| January | 0.60 | 0.60 | August | 7.25 | 8.45 |
| February | .90 | 1.10 | September | 5.95 | 6.65 |
| March | 1.05 | 1.15 | October | 3.10 | 3.55 |
| April | 2.45 | 2.85 | November | 1.30 | 1.55 |
| May | 3.45 | 3.70 | December | .95 | 1.05 |
| June | 6.50 | 7.00 | | | |
| July | 7.70 | 8.90 | Annual | 41.20 | 46.55 |

### CACHE CREEK AT LOWER LAKE, CAL.

This station was established January 1, 1900, by S. G. Bennett. It is located three-fourths mile from Lower Lake, Cal.

The channel is straight for 150 feet above and 300 feet below the station. The current has a moderate velocity at ordinary stages. The right bank is low, and will overflow at a gage height of about 10 feet. It is covered with a thick growth of willow and oak trees for 100 feet back from the water's edge. The left bank is high and rocky, and is not liable to overflow. The bed of the stream is composed of firm gravel, and changes only slightly. Gravel is sometimes washed in from Siegler Creek 300 feet below the cable.

Discharge measurements are made from a cable 300 feet above the wagon bridge. The initial point for soundings is a small tree in line with the cable on the left bank, 28 feet from the tree to which the cable is attached.

The present gage is a vertical plank nailed to a timber driven into the bed of the river and fastened to a large willow tree on the left bank 100 feet above the cable. On March 25, 1903, when the new gage was put in place, the reading was 5.7 feet. The old gage read 4.4 feet on the same date. During 1905 the gage was read once each day by Mr. J. R. Anderson. The bench mark is a nail in the root of the oak tree, to which cable is fastened on the left bank; elevation, 8.43 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Cache Creek at Lower Lake, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 1 | J. R. Anderson | 51 | 138 | 1.86 | 4.10 | 257 |
| January 7 | do | 51 | 146 | 2.05 | 4.20 | 300 |
| January 14[a] | do | 52 | 159 | 2.08 | 4.50 | 331 |
| January 15 | do | 52 | 159 | 2.35 | 4.50 | 373 |
| January 22 | do | 52 | 178 | 2.61 | 4.90 | 467 |
| January 23[a] | do | 56 | 222 | 1.35 | 5.60 | 299 |
| January 24 | do | 52 | 206 | 2.86 | 5.40 | 589 |
| January 26 | do | 53 | 218 | 3.09 | 5.60 | 673 |
| January 31 | do | 53 | 229 | 3.27 | 5.80 | 748 |
| February 1[a] | do | 60 | 273 | 2.06 | 6.48 | 562 |
| February 2[a] | do | 56 | 254 | 3.11 | 6.20 | 790 |
| February 9 | do | 56 | 266 | 3.63 | 6.40 | 965 |
| February 15 | do | 56 | 254 | 3.34 | 6.20 | 848 |
| February 21 | do | 56 | 258 | 3.44 | 6.30 | 886 |
| February 27 | do | 56 | 256 | 3.38 | 6.20 | 864 |
| March 5 | do | 56 | 249 | 3.33 | 6.10 | 828 |
| March 11 | do | 56 | 234 | 3.24 | 5.80 | 757 |
| March 13[a] | do | 60 | 286 | 2.18 | 6.68 | 625 |
| March 14 | do | 56 | 248 | 3.28 | 6.08 | 814 |
| March 20 | do | 59 | 271 | 3.52 | 6.52 | 955 |
| March 25 | do | 60 | 296 | 3.69 | 6.90 | 1,092 |
| March 31 | do | 60 | 308 | 3.76 | 7.10 | 1,159 |
| April 7 | do | 60 | 305 | 3.63 | 7.00 | 1,108 |
| April 15 | do | 56 | 277 | 3.55 | 6.60 | 984 |
| April 22 | do | 56 | 259 | 3.42 | 6.35 | 886 |
| April 29 | do | 56 | 248 | 3.34 | 6.10 | 829 |
| May 6 | do | 56 | 233 | 3.24 | 5.80 | 755 |
| July 11 | O. W. Peterson | 54 | 153 | 2.53 | 4.30 | 387 |
| September 29 | C. H. Lee | 53 | 86 | .93 | 2.83 | 80 |
| October 8 | J. R. Anderson | 48 | 73 | .86 | 2.70 | 63 |
| October 14 | do | 48 | 73 | .82 | 2.70 | 60 |
| October 21 | do | 48 | 68 | .70 | 2.60 | 48 |
| November 5 | do | 48 | 62 | .50 | 2.50 | 31 |
| November 11 | do | 48 | 61 | .46 | 2.45 | 28 |
| November 22 | do | 48 | 58 | .41 | 2.40 | 24 |
| November 27 | do | 48 | 54 | .37 | 2.30 | 20 |

[a] Backwater from Siegler Creek.

*Daily gage height, in feet, of Cache Creek at Lower Lake, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.1 | 6.5 | 6.2 | 7.3 | 5.9 | 5.3 | 4.5 | 3.8 | 3.25 | 2.8 | 2.5 | 2.5 |
| 2 | 4.1 | 6.2 | 6.15 | 7.1 | 6.0 | 5.3 | 4.5 | 3.8 | 3.2 | 2.8 | 2.5 | 2.5 |
| 3 | 4.15 | 6.25 | 6.15 | 7.05 | 6.0 | 5.25 | 4.45 | 3.75 | 3.2 | 2.8 | 2.5 | 2.45 |
| 4 | 4.2 | 6.25 | 6.1 | 7.0 | 5.95 | 5.25 | 4.4 | 3.75 | 3.2 | 2.8 | 2.5 | 2.45 |
| 5 | 4.2 | 6.35 | 6.1 | 7.0 | 5.90 | 5.2 | 4.4 | 3.7 | 3.2 | 2.8 | 2.5 | 2.45 |
| 6 | 4.2 | 6.4 | 6.1 | 7.0 | 5.8 | 5.2 | 4.4 | 3.7 | 3.15 | 2.8 | 2.5 | 2.4 |
| 7 | 4.2 | 6.4 | 6.05 | 7.0 | 6.05 | 5.15 | 4.4 | 3.7 | 3.15 | 2.75 | 2.45 | 2.4 |
| 8 | 4.2 | 6.4 | 6.0 | 7.0 | 6.0 | 5.15 | 4.4 | 3.7 | 3.15 | 2.75 | 2.45 | 2.4 |
| 9 | 4.2 | 6.4 | 6.0 | 6.9 | 5.9 | 5.1 | 4.35 | 3.7 | 3.1 | 2.75 | 2.45 | 2.4 |
| 10 | 4.2 | 6.4 | 5.9 | 6.8 | 5.85 | 5.1 | 4.35 | 3.7 | 3.1 | 2.7 | 2.45 | 2.35 |
| 11 | 4.2 | 6.3 | 5.8 | 6.8 | 5.8 | 5.05 | 4.3 | 3.65 | 3.1 | 2.7 | 2.45 | 2.35 |
| 12 | 4.2 | 6.3 | 6.2 | 6.85 | 5.8 | 5.0 | 4.3 | 3.65 | 3.05 | 2.7 | 2.45 | 2.35 |
| 13 | 4.3 | 6.3 | 6.45 | 6.75 | 5.8 | 4.95 | 4.25 | 3.65 | 3.05 | 2.7 | 2.4 | 2.35 |
| 14 | 4.5 | 6.3 | 6.2 | 6.6 | 5.75 | 4.95 | 4.25 | 3.6 | 3.05 | 2.7 | 2.4 | 2.35 |
| 15 | 4.5 | 6.2 | 6.2 | 6.65 | 5.75 | 4.9 | 4.2 | 3.6 | 3.05 | 2.7 | 2.4 | 2.45 |
| 16 | 4.7 | 6.2 | 6.3 | 6.55 | 5.8 | 4.9 | 4.15 | 3.6 | 3.0 | 2.7 | 2.4 | 2.45 |
| 17 | 4.75 | 6.3 | 6.4 | 6.45 | 5.7 | 4.85 | 4.15 | 3.55 | 3.0 | 2.65 | 2.4 | 2.35 |
| 18 | 4.75 | 6.3 | 6.3 | 6.4 | 5.7 | 4.85 | 4.1 | 3.55 | 3.0 | 2.65 | 2.4 | 2.45 |
| 19 | 4.8 | 7.0 | 6.6 | 6.5 | 5.7 | 4.8 | 4.1 | 3.5 | 2.95 | 2.6 | 2.4 | 2.5 |
| 20 | 4.8 | 6.3 | 6.55 | 6.3 | 5.6 | 4.8 | 4.1 | 3.5 | 2.95 | 2.6 | 2.5 | 2.5 |
| 21 | 4.9 | 6.3 | 6.7 | 6.35 | 5.6 | 4.75 | 4.05 | 3.5 | 2.9 | 2.6 | 2.35 | 2.45 |
| 22 | 5.85 | 6.35 | 6.8 | 6.35 | 5.5 | 4.75 | 4.05 | 3.45 | 2.9 | 2.6 | 2.4 | 2.4 |
| 23 | 5.55 | 6.35 | 6.8 | 6.3 | 5.5 | 4.75 | 4.0 | 3.45 | 2.9 | 2.6 | 2,25 | 2.5 |
| 24 | 5.7 | 6.3 | 6.95 | 6.25 | 5.5 | 4.7 | 4.0 | 3.45 | 2.9 | 2.6 | 2.3 | 2.5 |
| 25 | 5.65 | 6.25 | 6.95 | 6.25 | 5.45 | 4.7 | 4.0 | 3.4 | 2.9 | 2.6 | 2.3 | 2.5 |
| 26 | 5.65 | 6.25 | 7.1 | 6.2 | 5.4 | 4.65 | 4.0 | 3.4 | 2.9 | 2.6 | 2.35 | 2.5 |
| 27 | 5.75 | 6.2 | 6.95 | 6.2 | 5.4 | 4.6 | 4.0 | 3.35 | 2.9 | 2.6 | 2.3 | 2.45 |
| 28 | 5.8 | 6.2 | 6.75 | 6.15 | 5.4 | 4.6 | 3.95 | 3.35 | 2.85 | 2.55 | 2.65 | 2.4 |
| 29 | 5.8 | ....... | 7.2 | 6.1 | 5.4 | 4.55 | 3.9 | 3.35 | 2.85 | 2.55 | 2.5 | 2.4 |
| 30 | 5.8 | ....... | 7.2 | 6.05 | 5.45 | 4.5 | 3.9 | 3.3 | 2.8 | 2.55 | 2.5 | 2.5 |
| 31 | 5.8 | ....... | 7.1 | ....... | 5.4 | ....... | 3.85 | 3.3 | ....... | 2.5 | ....... | 2.55 |

*Station rating table for Cache Creek at Lower Lake, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.30 | 17 | 3.40 | 149 | 4.50 | 365 | 5.60 | 670 |
| 2.40 | 27 | 3.50 | 163 | 4.60 | 390 | 5.70 | 701 |
| 2.50 | 37 | 3.60 | 178 | 4.70 | 416 | 5.80 | 732 |
| 2.60 | 48 | 3.70 | 194 | 4.80 | 442 | 5.90 | 763 |
| 2.70 | 59 | 3.80 | 212 | 4.90 | 469 | 6.00 | 795 |
| 2.80 | 71 | 3.90 | 232 | 5.00 | 496 | 6.20 | 859 |
| 2.90 | 83 | 4.00 | 252 | 5.10 | 524 | 6.40 | 923 |
| 3.00 | 95 | 4.10 | 274 | 5.20 | 552 | 6.60 | 988 |
| 3.10 | 108 | 4.20 | 296 | 5.30 | 581 | 6.80 | 1,054 |
| 3.20 | 121 | 4.30 | 318 | 5.40 | 610 | 7.00 | 1,120 |
| 3.30 | 135 | 4.40 | 341 | 5.50 | 640 | 7.20 | 1,188 |

NOTE.—The above table is based on 28 discharge measurements made during 1905 and during the latter part of 1904. It is well defined throughout.

*Estimated monthly discharge of Cache Creek near Lower Lake, Cal., for 1905.*

[Drainage area, 500 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 748 | 274 | 448 | 27,550 | 0.896 | 1.03 |
| February | 1,120 | 562 | 884 | 49,100 | 1.77 | 1.84 |
| March | 1,188 | 610 | 933 | 57,370 | 1.87 | 2.16 |
| April | 1,222 | 811 | 991 | 58,970 | 1.98 | 2.21 |
| May | 811 | 610 | 702 | 43,160 | 1.40 | 1.61 |
| June | 581 | 365 | 476 | 28,320 | .952 | 1.06 |
| July | 365 | 222 | 294 | 18,080 | .588 | .678 |
| August | 212 | 135 | 173 | 10,640 | .346 | .399 |
| September | 128 | 71 | 98.5 | 5,861 | .197 | .220 |
| October | 71 | 37 | 56.0 | 3,443 | .112 | .129 |
| November | 54 | 12 | 30.1 | 1,791 | .060 | .067 |
| December | 42 | 22 | 30.7 | 1,888 | .061 | .070 |
| The year | 1,222 | 12 | 426 | 306,200 | .853 | 11.47 |

## CACHE CREEK NEAR YOLO, CAL.

This station was established January 1, 1903, by S. G. Bennett. It is located at the wagon bridge on the road from Woodland to Yolo, about 1,000 feet above the Southern Pacific Railroad bridge. A new wagon bridge, which greatly improves the channel conditions, was erected during 1904. The station was reestablished on the new bridge December 4, 1904.

Numerous diversions are made from Cache Creek above this station which take practically all of the summer flow. The channel is straight for 1,000 feet above and below the station. The current is swift at ordinary and high stages. The banks are steep and wooded and their height has been increased by levees. They are said to overflow at extreme high water. The bed of the stream is composed of earth and gravel, with a little sand, and is not subject to any material change.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is the end of the bridge on the right bank.

The gage is a staff in four sections, three of which are above the bridge and the fourth is bolted to the face of the concrete abutment on the right bank. During 1905 the gage was read by John Woodard. The bench mark is corner of top of concrete abutment to which the high-water section of gage is fastened and directly over gage; elevation, 31.68 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Cache Creek near Yolo, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| February 2 | O W. Peterson | 114 | 1,255 | 6.07 | 11.75 | 7,624 |
| February 3 | do | 107 | 833 | 5.83 | 8.30 | 4,860 |
| Do | do | 108 | 890 | 5.87 | 8.80 | 5,227 |
| February 4 | do | 102 | 630 | 6.03 | 7.05 | 3,802 |
| February 15 | do | 94 | 345 | 4.39 | 4.85 | 1,516 |
| May 16 | W. B. Clapp | 91 | 275 | 3.73 | 4.05 | 1,027 |
| June 5 | Peterson and Rodman | 89 | 215 | 3.25 | 3.40 | 699 |
| June 24 | O. W. Peterson | 89 | 151 | 2.37 | 2.60 | 358 |
| August 3 | do | 87 | 88 | 1.47 | 1.79 | 129 |
| September 7 | C. H. Lee | 32 | 19 | .67 | 1.26 | 13.0 |
| September 13 | W. B. Clapp | 17 | 7.3 | .64 | 1.15 | 4.7 |
| October 3 | Lee and Hawley | 2 | .5 | .80 | 1.09 | .4 |

*Daily gage height, in feet, of Cache Creek near Yolo, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 6.0 | 4.7 | 5.9 | 4.2 | 3.6 | 2.55 | 1.8 | 1.4 | 1.0 |
| 2 | 4.05 | 12.4 | 4.6 | 5.8 | 4.2 | 3.6 | 2.5 | 1.8 | 1.4 | 1.0 |
| 3 | 3.65 | 9.05 | 4.6 | 5.7 | 4.2 | 3.5 | 2.5 | 1.75 | 1.4 | 1.0 |
| 4 | 3.45 | 7.35 | 4.5 | 5.6 | 4.15 | 3.5 | 2.5 | 1.75 | 1.35 | 1.1 |
| 5 | 3.25 | 6.4 | 4.5 | 5.5 | 4.15 | 3.45 | 2.45 | 1.7 | 1.3 | 1.1 |
| 6 | 3.1 | 6.0 | 4.45 | 5.4 | 4.15 | 3.4 | 2.45 | 1.7 | 1.3 | 1.1 |
| 7 | 3.1 | 5.6 | 4.4 | 5.3 | 4.1 | 3.35 | 2.4 | 1.7 | 1.25 | 1.1 |
| 8 | 3.05 | 5.35 | 4.4 | 5.2 | 4.75 | 3.3 | 2.4 | 1.75 | 1.25 | 1.1 |
| 9 | 3.0 | 5.2 | 4.35 | 5.2 | 4.5 | 3.25 | 2.4 | 1.8 | 1.2 | 1.1 |
| 10 | 3.0 | 5.1 | 4.35 | 5.1 | 4.4 | 3.2 | 2.35 | 1.8 | 1.15 | 1.05 |
| 11 | 3.0 | 5.0 | 4.3 | 5.1 | 4.3 | 3.15 | 2.3 | 1.75 | 1.15 | 1.05 |
| 12 | 2.95 | 4.95 | 4.3 | 5.05 | 4.25 | 3.1 | 2.25 | 1.75 | 1.1 | 1.05 |
| 13 | 3.2 | 4.9 | 5.65 | 5.0 | 4.2 | 3.1 | 2.2 | 1.7 | 1.1 | 1.1 |
| 14 | 9.95 | 4.8 | 6.05 | 5.0 | 4.2 | 3.05 | 2.2 | 1.7 | 1.1 | 1.1 |
| 15 | 6.4 | 4.8 | 5.85 | 4.9 | 4.15 | 3.05 | 2.15 | 1.65 | 1.15 | 1.1 |
| 16 | 5.3 | 4.75 | 6.4 | 4.9 | 4.15 | 3.0 | 2.15 | 1.65 | 1.1 | 1.1 |
| 17 | 7.4 | 5.3 | 6.2 | 4.85 | 4.1 | 3.0 | 2.1 | 1.65 | 1.1 | ........ |
| 18 | 7.0 | 5.25 | 5.7 | 4.8 | 4.1 | 3.0 | 2.1 | 1.6 | 1.1 | ........ |
| 19 | 6.55 | 5.2 | 6.0 | 4.75 | 4.1 | 2.95 | 2.0 | 1.6 | 1.15 | ........ |
| 20 | 5.3 | 5.1 | 6.0 | 4.7 | 4.05 | 2.9 | 2.0 | 1.6 | 1.15 | ........ |
| 21 | 5.05 | 5.0 | 5.95 | 4.65 | 4.05 | 2.9 | 1.95 | 1.6 | 1.1 | ........ |
| 22 | 8.25 | 5.0 | 5.9 | 4.6 | 4.0 | 2.85 | 1.9 | 1.65 | 1.1 | ........ |
| 23 | 15.55 | 4.95 | 6.3 | 4.55 | 4.0 | 2.8 | 1.9 | 1.55 | 1.05 | ........ |
| 24 | 8.8 | 4.9 | 6.2 | 4.5 | 3.95 | 2.8 | 1.85 | 1.55 | 1.05 | ........ |
| 25 | 9.25 | 4.85 | 6.1 | 4.45 | 3.95 | 2.75 | 1.8 | 1.55 | 1.05 | ........ |
| 26 | 7.0 | 4.8 | 6.05 | 4.4 | 3.9 | 2.7 | 1.8 | 1.5 | 1.05 | ........ |
| 27 | 6.2 | 4.8 | 6.0 | 4.35 | 3.9 | 2.7 | 1.75 | 1.5 | 1.05 | ........ |
| 28 | 5.8 | 4.7 | 5.9 | 4.3 | 3.8 | 2.65 | 1.75 | 1.5 | 1.05 | ........ |
| 29 | 5.4 | ........ | 7.1 | 4.25 | 3.8 | 2.6 | 1.6 | 1.45 | 1.0 | ........ |
| 30 | 5.15 | ........ | 6.85 | 4.2 | 3.7 | 2.6 | 1.6 | 1.45 | 1.0 | ........ |
| 31 | 5.0 | ........ | 6.1 | ........ | 3.7 | ........ | 1.6 | 1.4 | ........ | ........ |

**Note.**—Creek dry October 17 to December 31.

*Station rating table for Cache Creek near Yolo, Cal., from January 1, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 0 | 2.60 | 361 | 4.40 | 1,230 | 7.60 | 3,635 |
| 1.10 | 1 | 2.70 | 395 | 4.60 | 1,350 | 7.80 | 3,815 |
| 1.20 | 7 | 2.80 | 430 | 4.80 | 1,480 | 8.00 | 4,000 |
| 1.30 | 17 | 2.90 | 467 | 5.00 | 1,610 | 8.50 | 4,475 |
| 1.40 | 32 | 3.00 | 505 | 5.20 | 1,745 | 9.00 | 4,970 |
| 1.50 | 53 | 3.10 | 550 | 5.40 | 1,885 | 9.50 | 5,470 |
| 1.60 | 76 | 3.20 | 595 | 5.60 | 2,025 | 10.00 | 5,980 |
| 1.70 | 100 | 3.30 | 640 | 5.80 | 2,170 | 10.50 | 6,505 |
| 1.80 | 125 | 3.40 | 690 | 6.00 | 2,320 | 11.00 | 7,050 |
| 1.90 | 151 | 3.50 | 740 | 6.20 | 2,470 | 11.50 | 7,600 |
| 2.00 | 178 | 3.60 | 790 | 6.40 | 2,625 | 12.00 | 8,150 |
| 2.10 | 206 | 3.70 | 840 | 6.60 | 2,785 | 13.00 | 9,300 |
| 2.20 | 235 | 3.80 | 890 | 6.80 | 2,945 | 14.00 | 10,500 |
| 2.30 | 265 | 3.90 | 945 | 7.00 | 3,110 | 15.00 | 11,700 |
| 2.40 | 296 | 4.00 | 1,000 | 7.20 | 3,280 | 16.00 | 12,950 |
| 2.50 | 328 | 4.20 | 1,110 | 7.40 | 3,455 | | |

NOTE.—The above table is based on 12 discharge measurements made during 1905. It is well defined between gage heights 0 and 5 feet.

*Estimated monthly discharge of Cache Creek near Yolo, Cal., for 1905.*

[Drainage area, 1,280 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 12,390 | 486 | 2,313 | 142,200 | 1.81 | 2.09 |
| February | 8,610 | 1,415 | 2,142 | 119,000 | 1.67 | 1.74 |
| March | 3,195 | 1,170 | 1,969 | 121,100 | 1.54 | 1.78 |
| April | 2,245 | 1,110 | 1,576 | 93,780 | 1.23 | 1.37 |
| May | 1,448 | 840 | 1,058 | 65,050 | .827 | .953 |
| June | 790 | 361 | 542 | 32,250 | .423 | .472 |
| July | 344 | 76 | 214 | 13,160 | .167 | .192 |
| August | 125 | 32 | 86.5 | 5,319 | .068 | .078 |
| September | 32 | 0 | 7.1 | 423 | .0055 | .0061 |
| October | 1 | 0 | .32 | 20 | .00025 | .00029 |
| November | 0 | 0 | 0 | 0 | 0 | 0 |
| December | 0 | 0 | 0 | 0 | 0 | 0 |
| The year | 12,390 | 0 | 826 | 592,300 | .645 | 8.68 |

NOTE.—Estimates January 1 to February 10 are subject to considerable error owing to the scouring and filling at this section during high water.

### MISCELLANEOUS MEASUREMENTS IN CACHE CREEK DRAINAGE BASIN.

*Clover Creek near Upper Lake, Cal.*—This stream discharges into Clear Lake. A measurement was made July 12 by O. W. Peterson, one-third of a mile above town of Upper Lake.

Width, 9.2 feet; area, 5.5 square feet; mean velocity, 0.49 foot per second; discharge, 2.7 second-feet.

*Cole Creek at Kelseyville, Cal.*—This stream discharges into Clear Lake. A measurement was made July 11, 1905, by O. W. Peterson, near Kelseyville and Lower Lake road, three-fourths of a mile below Kelseyville.

Width, 11.5 feet; area, 4.3 square feet; mean velocity, 1.00 foot per second; discharge, 4.3 second-feet.

*Capay ditch at Capay, Cal.*—This ditch diverts water from Cache Creek. The following measurements were made at head of ditch at Capay by O. W. Peterson.

June 19: Width, 18.8 feet; area, 34 square feet; mean velocity, 1.80 feet per second; discharge, 61 second-feet.

August 2: Width, 18.8 feet; area, 21 square feet; mean velocity, 1.57 feet per second; gage-height, 1.10 feet; discharge, 33 second-feet.

*Kelsey Creek near Kelseyville, Cal.*—This stream discharges into Clear Lake. A measurement was made July 11 by O. W. Peterson, 1¼ miles above Kelsey Creek Mill, about 3½ miles above the town of Kelseyville.

Width, 16.5 feet; area, 9 square feet; mean velocity, 1.29 feet per second; discharge, 11.6 second-feet.

*Middle Creek near Upper Lake, Cal.*—This stream discharges into Clear Lake. A measurement was made July 12 by O. W. Peterson, 1½ miles above the town of Upper Lake in sec. 31, T. 15 N, R. 9 W, M. D. M.

Width, 9.9 feet; area, 8.3 square feet; mean velocity, 0.48 foot per second; discharge, 4.0 second-feet.

*Moore's ditch near Woodland, Cal.*—The following measurements were made at Walker Bridge, one-half mile below canal heading:

June 3: Width, 21.6 feet; area, 89 square feet; mean velocity, 0.90 foot per second; discharge, 80 second-feet.

June 3: Width, 20 feet; area, 102 square feet; mean velocity, 1.69 feet per second; discharge, 172 second-feet.

June 17: Width, 24.5 feet; area, 72 square feet; mean velocity, 0.83 foot per second; gage height, 4.20 feet; discharge, 60 second-feet.

June 17: Width, 26 feet; area, 89 square feet; mean velocity, 1.13 feet per second; gage height, 4.80 feet; discharge, 101 second-feet.

June 17: Width, 35 feet; area, 119 square feet; mean velocity, 1.36 feet per second; gage height, 5.55 feet; discharge, 162 second-feet.

June 21: Width, 25.2 feet; area, 74 square feet; mean velocity, 1.65 feet per second; gage height, 5.45 feet; discharge, 122 second-feet.

August 2: Width, 19.8 feet; area, 87 square feet; mean velocity, 1.14 feet per second; gage height, 4.40 feet; discharge, 99 second-feet.

## AMERICAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

American River drains an area of about 2,000 square miles of the western slope of the Sierra Nevada. This drainage basin lies between those of the Bear and Yuba rivers on the north and that of Consumnes River on the south. It has three main forks, heading in the summit of the range, which reaches an elevation of about 9,000 feet. The country lying between these main forks is drained by numerous small tributaries. The formation in the higher and greater portions of this basin is of granite, with a considerable timber growth. The flow is rather torrential during the winter months, due to the large area of barren and sparsely timbered country in the lower portion of the watershed. The precipitation on the higher elevations is in the form of snow, which usually melts late in the spring. Rainfall records have been kept along the line of the Central Pacific Railroad, which follows the ridge to the north of North Fork.

The mean annual rainfall at Auburn is 33.40 inches, that at Colfax 47.4 inches, and at Cisco and Emigrant Gap about 50 inches. At Georgetown, between North and Middle forks, a 30-year record has an average of 56.72 inches, and at Placerville, above South Fork, another of about the same length shows 43.58 inches.

There are several small lakes in the upper reaches of this basin, the storage capacity of a few having been increased by the construction of low dams at their outlets. This stored water is used for mining purposes during the low-water flow and is used entirely within the drainage basin.

### AMERICAN RIVER NEAR FAIROAKS, CAL.

This station was established November 3, 1904, by O. W. Peterson. It is located at Fairoaks Bridge, near Fairoaks.

The channel is straight for 400 feet above and below the station. At ordinary stages the velocity is sluggish. The right bank is not subject to overflow. At times of very high water the left bank is subject to overflow and a second channel is formed. The bed of the stream is composed of gravel, and is subject to slight changes at times of high water. At ordinary stages the river is about 210 feet in width and averages over 4 feet in depth.

Discharge measurements are made from the downstream side of the bridge. The vertical face of the right abutment is 4 feet from the initial point for soundings.

The gage is a staff nailed to one of the piles at the upper side at the right end of Fairoaks Bridge. During 1905 the gage was read twice each day by W. F. Bailey, jr. The bench mark is a nail driven in the guard rail over the upstream center pier; elevation, 31.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134 of the United States Geological Survey.

*Discharge measurements of American River near Fairoaks, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 26 | F. R. S. Buttemer | 356 | 1,648 | 2.41 | 4.52 | 3,971 |
| January 26 | do | 356 | 1,648 | 2.42 | 4.49 | 3,994 |
| February 2 | do | 373 | 2,891 | 4.35 | 7.55 | 12,580 |
| February 11 | do | 353 | 1,505 | 2.09 | 4.08 | 3,151 |
| February 17 | do | 354 | 1,544 | 2.19 | 4.22 | 3,378 |
| February 22 | do | 355 | 1,776 | 2.67 | 4.90 | 4,742 |
| May 17 | W. B. Clapp | 370 | 2,864 | 4.34 | 7.35 | 12,340 |
| June 28 | O. W. Peterson | 260 | 993 | 1.53 | 2.88 | 1,520 |
| July 29 | Peterson and Lee | 167 | 694 | .56 | 1.46 | 392 |
| September 4 | C. H. Lee | 165 | 599 | .20 | .88 | 119 |

*Daily gage height, in feet, of American River near Fairoaks, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.1 | 4.25 | 4.6 | 5.95 | 6.0 | 4.6 | 2.85 | 1.4 | 0.9 | 0.95 | 0.95 | 1.35 |
| 2 | 5.25 | 7.6 | 4.6 | 6.15 | 6.1 | 4.55 | 2.75 | 1.4 | .9 | .9 | .95 | 1.25 |
| 3 | 3.95 | 5.85 | 4.6 | 5.95 | 5.9 | 4.45 | 2.7 | 1.4 | .9 | .95 | .95 | 1.2 |
| 4 | 3.65 | 5.05 | 4.55 | 6.0 | 5.6 | 4.55 | 2.7 | 1.4 | .9 | .95 | .95 | 1.25 |
| 5 | 3.5 | 6.65 | 4.6 | 6.15 | 5.55 | 4.45 | 2.65 | 1.35 | .85 | .95 | .95 | 1.1 |
| 6 | 3.35 | 5.5 | 4.6 | 6.0 | 5.5 | 5.1 | 2.6 | 1.35 | .9 | .95 | .95 | 1.15 |
| 7 | 3.6 | 4.9 | 4.6 | 6.15 | 5.6 | 5.15 | 2.5 | 1.35 | .9 | .95 | .95 | 1.2 |
| 8 | 3.6 | 4.45 | 4.6 | 5.75 | 5.55 | 5.2 | 2.5 | 1.35 | .9 | .9 | .95 | 1.15 |
| 9 | 3.9 | 4.25 | 4.5 | 5.65 | 5.8 | 5.35 | 2.4 | 1.3 | .85 | .95 | .95 | 1.15 |
| 10 | 3.1 | 4.2 | 4.3 | 5.8 | 5.5 | 4.6 | 2.3 | 1.3 | .9 | .9 | 1.0 | 1.15 |
| 11 | 3.0 | 4.1 | 4.45 | 5.5 | 5.2 | 4.7 | 2.2 | 1.3 | .9 | .95 | 1.0 | 1.0 |
| 12 | 3.0 | 4.05 | 4.6 | 5.65 | 5.2 | 4.6 | 2.15 | 1.3 | .85 | .95 | 1.0 | 1.0 |
| 13 | 2.95 | 3.85 | 4.8 | 4.85 | 5.0 | 4.35 | 2.05 | 1.3 | .9 | .95 | 1.0 | .9 |
| 14 | 3.5 | 3.7 | 5.1 | 5.25 | 5.55 | 4.1 | 2.0 | 1.25 | .9 | .95 | .95 | .95 |
| 15 | 4.65 | 3.6 | 5.15 | 5.1 | 6.15 | 4.2 | 1.9 | 1.25 | .9 | 1.0 | .95 | 1.0 |
| 16 | 4.55 | 3.4 | 4.55 | 4.85 | 6.7 | 4.0 | 1.8 | 1.25 | 1.0 | .95 | 1.0 | 1.1 |
| 17 | 3.9 | 4.35 | 4.75 | 4.7 | 6.95 | 3.85 | 1.8 | 1.25 | .95 | .95 | 1.05 | 1.1 |
| 18 | 3.85 | 4.25 | 4.9 | 4.55 | 6.65 | 3.8 | 1.7 | 1.25 | 1.0 | .95 | .9 | 1.15 |
| 19 | 3.95 | 4.15 | 10.5 | 4.65 | 6.5 | 3.8 | 1.65 | 1.2 | .9 | .95 | 1.0 | 1.2 |
| 20 | 3.9 | 6.15 | 7.45 | 4.9 | 6.4 | 3.8 | 1.6 | 1.2 | .95 | .95 | 1.05 | 1.1 |
| 21 | 4.1 | 5.2 | 7.1 | 5.4 | 5.95 | 3.85 | 1.55 | 1.2 | .95 | .95 | 1.0 | 1.05 |
| 22 | 4.8 | 4.85 | 6.7 | 6.5 | 5.3 | 3.55 | 1.5 | 1.2 | .9 | .95 | 1.15 | 1.05 |
| 23 | 6.85 | 4.6 | 6.1 | 7.4 | 5.5 | 3.7 | 1.5 | 1.2 | .95 | .95 | 1.0 | 1.2 |
| 24 | 6.4 | 4.5 | 6.55 | 8.85 | 5.7 | 3.3 | 1.5 | 1.1 | .95 | .95 | 1.15 | 1.3 |
| 25 | 5.4 | 4.55 | 6.3 | 7.65 | 6.1 | 3.15 | 1.45 | 1.1 | .9 | 1.0 | 1.0 | 1.2 |
| 26 | 4.45 | 4.9 | 6.5 | 7.1 | 5.9 | 3.1 | 1.45 | 1.1 | .9 | .95 | 1.1 | 1.3 |
| 27 | 4.25 | 4.7 | 6.8 | 6.6 | 5.5 | 2.9 | 1.45 | 1.1 | .95 | .95 | 1.0 | 1.4 |
| 28 | 3.9 | 4.75 | 6.4 | 6.7 | 5.35 | 2.8 | 1.45 | 1.0 | .95 | 1.0 | 1.4 | 1.4 |
| 29 | 3.8 | ....... | 6.85 | 6.8 | 4.75 | 2.75 | 1.45 | 1.0 | .95 | .95 | 1.75 | 1.55 |
| 30 | 3.75 | ....... | 6.35 | 6.75 | 4.5 | 2.7 | 1.4 | 1.0 | .95 | .95 | 1.5 | 1.7 |
| 31 | 3.85 | ....... | 5.95 | ....... | 4.15 | ....... | 1.4 | 1.0 | ....... | ....... | ....... | 1.45 |

NOTE. Gage heights estimated July 2-28; July 30 to September 2; November 1-9.

*Station rating table for American River near Fairoaks, Cal., from November 4 to December 31, 1904.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.40 | 700 | 2.70 | 990 | 3.00 | 1,300 | 3.30 | 1,680 |
| 2.50 | 790 | 2.80 | 1,090 | 3.10 | 1,410 | | |
| 2.60 | 890 | 2.90 | 1,190 | 3.20 | 1,540 | | |

**NOTE.**—The above table is based on 2 discharge measurements made during 1904, and on the 1905 curve.

*Station rating table for American River near Fairoaks, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.80 | 90 | 2.20 | 840 | 3.60 | 2,410 | 6.00 | 7,450 |
| 0.90 | 120 | 2.30 | 920 | 3.70 | 2,555 | 6.20 | 8,040 |
| 1.00 | 155 | 2.40 | 1,005 | 3.80 | 2,705 | 6.40 | 8,670 |
| 1.10 | 195 | 2.50 | 1,095 | 3.90 | 2,860 | 6.60 | 9,340 |
| 1.20 | 240 | 2.60 | 1,195 | 4.00 | 3,020 | 6.80 | 10.040 |
| 1.30 | 285 | 2.70 | 1,300 | 4.20 | 3,365 | 7.00 | 10,770 |
| 1.40 | 335 | 2.80 | 1,410 | 4.40 | 3.730 | 7.20 | 11,530 |
| 1.50 | 390 | 2.90 | 1,525 | 4.60 | 4,115 | 7.40 | 12,310 |
| 1.60 | 445 | 3.00 | 1,640 | 4.80 | 4,520 | 7.60 | 13,090 |
| 1.70 | 505 | 3.10 | 1,760 | 5.00 | 4,950 | 7.80 | 13,890 |
| 1.80 | 565 | 3.20 | 1,880 | 5.20 | 5,405 | 8.00 | 14,700 |
| 1.90 | 630 | 3.30 | 2,005 | 5.40 | 5,880 | | |
| 2.00 | 695 | 3.40 | 2,135 | 5.60 | 6,375 | | |
| 2.10 | 765 | 3.50 | 2,270 | 5.80 | 6,900 | | |

NOTE.—The above table is based on 10 discharge measurements made during 1905. It is fairly well defined between gage heights 0.8 foot and 5 feet.

*Estimated monthly discharge of American River near Fairoaks, Cal., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| November 4-30 | 1,355 | 700 | 896 | 47,980 |
| December | 13,600 | 700 | 1,404 | 86,330 |
| 1905. | | | | |
| January | 10,220 | 1,582 | 3,549 | 218,200 |
| February | 13,090 | 2,135 | 4,630 | 257,100 |
| March | 25,900 | 3,545 | 6,924 | 425,700 |
| April | 18,300 | 4,018 | 7,736 | 460,300 |
| May | 10,580 | 3,278 | 6,717 | 413,000 |
| June | 5,760 | 1,300 | 3,231 | 192,300 |
| July | 1,468 | 335 | 719 | 44,210 |
| August | 335 | 155 | 255 | 15,680 |
| September | 155 | 105 | 126 | 7,498 |
| October | 155 | 120 | 138 | 8,485 |
| November | 535 | 120 | 181 | 10,770 |
| December | 505 | 120 | 242 | 14,880 |
| The year | 25,900 | 105 | 2,874 | 2,068,000 |

## MISCELLANEOUS MEASUREMENTS IN AMERICAN RIVER DRAINAGE BASIN.

*South Fork of American River near Placerville, Cal.*—A measurement was made August 20, 1905, at Chillie Bar, 3 miles north of Placerville and 400 yards upstream from wagon bridge, by H. A. Campbell. The distance to water surface from top of outer bar, of lower chord in the middle panel, on the upstream side of bridge was 23.5 feet.

Width, 28 feet; area, 42 square feet; mean velocity, 1.80 feet per second; discharge, 76 second-feet.

*North Fork of the American River near Auburn, Cal.*—A measurement was made about 400 yards above junction of North and Middle forks and about 2 miles northeast of Auburn on August 21, 1905, by H. A. Campbell.

Width, 28 feet; area, 44 square feet; mean velocity, 1.48 feet per second; discharge, 65 second-feet.

*Middle Fork of the American River near Auburn, Cal.*—A measurement was made on this stream about 400 yards above junction of the North and Middle forks and about 2 miles northeast of Auburn, Cal., on August 21, 1905, by H. A. Campbell.

Width, 55 feet; area, 101 square feet; mean velocity, 0.97 foot per second; discharge, 98 second-feet.

*El Dorado ditch.*—This ditch is taken out of South Fork of the American River about 1 mile below Slippery Ford. A measurement was made at the heading on August 24, 1905, by H. A. Campbell.

Width, 13.9 feet; area, 45 square feet; mean velocity, 1.24 feet per second; discharge, 56 second-feet.

*Silver Fork of American River.*—This stream enters South Fork of American River about 1 mile below Slippery Ford. A measurement was made on August 24, 1905, just above mouth, by H. A. Campbell.

Width, 11 feet; area, 18.3 square feet; mean velocity, 1.07 feet per second; discharge, 19.6 second-feet.

*South Fork of American River.*—A measurement was made one-fourth of a mile above Silver Fork and three-fourths mile below Slippery Ford on August 25, 1905, by H. A. Campbell.

Width, 26 feet; area, 63 square feet; mean velocity, 0.54 foot per second; discharge, 34 second-feet.

*South Fork of Silver Creek.*—A measurement was made on this stream August 26, 1905, about 200 feet above the mouth by H. A. Campbell.

Width, 16.5 feet; area, 21 square feet; mean velocity, 0.30 foot per second; discharge, 6.3 second-feet.

*Silver Creek.*—A measurement was made August 26, 1905, 100 feet above the mouth of South Fork of Silver Creek by H. A. Campbell.

Width, 11 feet; area, 16.2 square feet; mean velocity, 0.92 foot per second; discharge, 14.9 second-feet.

## PUTA CREEK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Puta Creek drains a portion of the eastern slope of the Coast Range, its waters discharging into Sacramento River through what is known as the Yolo basin in the vicinity of Davis, Cal. This basin is rather long and narrow, extending from west to east; it has numerous tributaries which have a heavy flood discharge during the winter months, but are practically dry during the summer. This stream is torrential in its flow. It has a comparatively small drainage basin with an exceptionally heavy rainfall, especially on the higher elevations in the vicinity of Mount St. Helena. A five-year rainfall record at Helen Mine on the northern slope of Mount St. Helena gives an average of 99.52 inches. The precipitation decreases as we approach the lower elevations. The upper reaches of this basin are well timbered, but the lower portion is comparatively barren of timber, though it has a considerable growth of brush extending to a point where the stream leaves the foothills. The areas in the lower portion of the basin are used principally for pasturage. The topography of the country is rough and precipitous. The underlying rock is an impervious slate and serpentine with a thin soil covering. There is comparatively little tilled land in this drainage basin above the point where the stream emerges from the foothills at Winters. Below this point the soil is deep and susceptible to high cultivation, and at present is used for the raising of grain and fruit.

## PUTA CREEK NEAR GUENOC, CAL.

This station was established February 12, 1904. It is located about 2 miles below the old town of Guenoc, near the Asbill ranch house and at the Guenoc dam site. The nearest post-office is at Middletown, Cal.

The bed of the stream is gravelly, with a few bowlders above and below the section. Bed rock is laid bare on the right side of the channel. The left bank is high and rocky, while the right bank is rather low and flat and subject to overflow in very high water. The velocity is moderate for ordinary stages of flow, but high in flood periods. The range is about 12 feet, representing discharges of from 7 to 17,000 second-feet. The channel is straight for several hundred feet upstream, but has several large bowlders in it. Downstream it is straight for about 100 feet. The section is located in a narrow gorge at the lower end of a long, flat valley, which is flooded during high water. The channel will not allow the water to run off through the gorge fast enough to prevent backwater forming during flood periods.

Meter measurements during high water are made from a car and cable. At first the cable was located directly opposite the ranch house, but as the location proved very unfavorable it was moved November 15, 1904, to a point about 1,000 feet below. It now has a clear span of about 200 feet. The initial point for soundings is the eyebolt to which the cable is fastened on the left bank. An auxiliary cable has been placed parallel to the large one, so that float measurements can be made in time of very high water. During low water measurements are made by wading.

The gage, which was established near the old section, is still read, although a new one was placed near the cable in its present position. The old gage is a staff in two sections, both being fastened to trees. The section which is read in low water is about 600 feet upstream from the ranch stable, and the high-water section is directly opposite the stable. The new rod is made similarly to the other one. Both sections are located a few feet above the cable. One is bolted to a large bowlder on the left bank and the other nailed to a tree on the right bank. During 1905 the gage was read once each day during ordinary stages and twice a day during high water by Miss Agnes Asbill. The bench mark is the top of the rock to which the low-water section of the new gage is fastened; elevation, 7.62 feet above the datum of the new gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Puta Creek near Guenoc, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 1 | F. R. S. Buttemer | 81 | 433 | 1.37 | 5.58 | 592 |
| January 1 | do | 76 | 390 | 1.36 | 5.42 | 530 |
| January 2 | do | 66 | 342 | 1.13 | 5.14 | 386 |
| January 2[a] | do | 66 | 321 | 1.12 | 5.12 | 359 |
| January 3 | do | 66 | 322 | 0.90 | 4.94 | 289 |
| January 4 | do | 64 | 316 | 0.78 | 4.82 | 247 |
| January 14 | do | 110 | 624 | 2.94 | 7.04 | 1,834 |
| January 15 | do | 95 | 478 | 1.83 | 5.96 | 876 |
| January 16 | do | 94 | 429 | 2.04 | 5.86 | 875 |
| January 16 | do | 95 | 467 | 2.08 | 5.98 | 972 |
| July 8 | O. W. Peterson | 16 | 12 | 1.58 | 3.72 | 19 |
| September 29 | C. H. Lee | 8 | 4.1 | 1.66 | 3.56 | 6.8 |

[a] Float measurement.

*Daily gage height, in feet, of Puta Creek near Guenoc, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.8 | 7.0 | 4.5 | 5.2 | 4.3 | [a]4.0 | 3.6 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 2 | [a]6.0 | 6.5 | 4.4 | 5.2 | 4.3 | 4.0 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 3 | [a]5.4 | 6.2 | 4.3 | 5.2 | 4.3 | 3.9 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 4 | 4.8 | 6.0 | 4.2 | 5.1 | 4.4 | 5.4 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 5 | 4.7 | 6.3 | 4.4 | 5.1 | 4.3 | 5.6 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 6 | 4.4 | 6.0 | 4.4 | 5.1 | 4.3 | 5.0 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 7 | 4.4 | 5.8 | 4.3 | 5.0 | 5.0 | 4.2 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 8 | 4.5 | 5.5 | 4.3 | 5.0 | 5.2 | 4.2 | 3.7 | 3.6 | [a]3.6 | 3.7 | 3.6 | 3.6 |
| 9 | 4.7 | 5.4 | 4.2 | 5.1 | 4.8 | 4.1 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 10 | 4.6 | 5.1 | 4.2 | 5.1 | 4.6 | 4.1 | 3.7 | [a]3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 11 | 4.5 | 5.0 | 4.2 | 5.0 | 4.4 | 4.0 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 12 | 4.5 | 4.9 | 4.5 | 5.0 | 4.4 | 4.0 | 3.7 | 3.6 | [a]3.6 | 3.7 | 3.6 | 3.6 |
| 13 | 6.1 | 4.8 | 5.5 | 5.0 | 4.4 | 3.9 | 3.7 | 3.6 | 3.6 | 3.7 | 3.6 | 3.6 |
| 14 | 7.45 | 4.7 | 6.5 | 5.0 | 4.4 | 3.9 | 3.7 | 3.5 | 3.6 | 3.7 | 3.6 | 3.6 |
| 15 | 5.9 | 4.6 | 6.0 | 5.1 | 4.3 | 3.9 | 3.6 | 3.5 | 3.6 | [a]3.7 | 3.6 | 3.7 |
| 16 | 5.9 | 4.9 | 6.2 | 5.2 | 4.3 | 3.9 | 3.6 | 3.5 | 3.6 | 3.7 | 3.6 | 3.8 |
| 17 | 4.4 | 5.1 | 6.0 | 5.2 | 4.3 | 3.9 | 3.6 | 3.5 | 3.6 | 3.7 | 3.6 | 3.8 |
| 18 | 4.5 | 5.4 | 6.5 | 5.1 | 4.2 | 3.8 | 3.6 | 3.5 | [a]3.6 | 3.7 | 3.6 | 3.8 |
| 19 | 6.45 | 6.3 | 6.85 | 5.0 | 4.2 | 3.8 | 3.5 | 3.5 | 3.6 | 3.7 | 3.6 | 3.8 |
| 20 | 5.4 | 6.0 | 6.1 | 4.9 | 4.2 | 3.8 | 3.5 | 3.6 | 3.6 | 3.7 | 3.6 | 3.8 |
| 21 | 6.8 | 5.9 | 5.9 | 4.9 | 4.2 | 3.8 | 3.5 | [a]3.6 | 3.6 | 3.6 | 3.6 | 3.7 |
| 22 | 13.5 | 5.7 | 5.8 | 4.8 | 4.1 | 3.8 | 3.5 | 3.6 | 3.6 | 3.6 | 3.6 | 3.7 |
| 23 | 8.9 | 5.4 | 5.8 | 4.8 | 4.1 | 3.8 | 3.5 | 3.6 | 3.6 | 3.6 | 3.6 | 3.7 |
| 24 | 7.2 | 5.2 | 5.7 | 4.7 | 4.1 | 3.8 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 4.0 |
| 25 | 6.7 | 5.0 | 5.4 | 4.6 | 4.1 | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 4.1 |
| 26 | 6.0 | 4.8 | 5.0 | 4.5 | 4.0 | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.9 |
| 27 | 5.9 | 4.7 | 5.8 | 4.4 | 4.0 | 3.7 | [a]3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.9 |
| 28 | 5.7 | 4.6 | 5.8 | 4.3 | 4.0 | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | [a]3.9 |
| 29 | 5.6 | ....... | 7.5 | 4.3 | 4.0 | 3.7 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.8 |
| 30 | 5.4 | ....... | 5.8 | [a]4.3 | 4.0 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | [a]3.6 | 3.8 |
| 31 | 5.8 | ....... | 5.5 | ....... | 4.0 | ....... | 3.6 | 3. | ....... | 3.6 | ....... | 3.7 |

[a] Interpolated

*Station rating table for Puta Creek near Guenoc, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.50 | 4 | 5.00 | 310 | 6.50 | 1,360 | 9.00 | 5,000 |
| 3.60 | 10 | 5.10 | 350 | 6.60 | 1,450 | 9.20 | 5,400 |
| 3.70 | 18 | 5.20 | 395 | 6.70 | 1,545 | 9.40 | 5,800 |
| 3.80 | 28 | 5.30 | 445 | 6.80 | 1,640 | 9.60 | 6,230 |
| 3.90 | 42 | 5.40 | 500 | 6.90 | 1,740 | 9.80 | 6,690 |
| 4.00 | 58 | 5.50 | 560 | 7.00 | 1,840 | 10.00 | 7,150 |
| 4.10 | 75 | 5.60 | 625 | 7.20 | 2,060 | 10.50 | 8,300 |
| 4.20 | 93 | 5.70 | 695 | 7.40 | 2,290 | 11.00 | 9,450 |
| 4.30 | 112 | 5.80 | 770 | 7.60 | 2,540 | 11.50 | 10,600 |
| 4.40 | 133 | 5.90 | 850 | 7.80 | 2,820 | 12.00 | 11,800 |
| 4.50 | 156 | 6.00 | 930 | 8.00 | 3,130 | 12.50 | 13,000 |
| 4.60 | 181 | 6.10 | 1,010 | 8.20 | 3,460 | 13.00 | 14,200 |
| 4.70 | 208 | 6.20 | 1,095 | 8.40 | 3,810 | 14.00 | 16,700 |
| 4.80 | 238 | 6.30 | 1,180 | 8.60 | 4,200 | | |
| 4.90 | 272 | 6.40 | 1,270 | 8.80 | 4,600 | | |

NOTE.—The above table is based on 17 discharge measurements made during 1904-5. It is well defined between gage heights 3.5 feet and 7 feet. Above 7 feet the table depends on 2 measurements at 12 feet and 13.7 feet. Above 9 feet the table is the same as for 1904.

*Estimated monthly discharge of Puta Creek near Guenoc, Cal., for 1905.*

[Drainage area, 91 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 15,450 | 133 | 1,344 | 82,640 | 14.77 | 17.03 |
| February | 1,840 | 181 | 619 | 34,380 | 6.80 | 7.08 |
| March | 1,690 | 93 | 630 | 38,740 | 6.92 | 7.98 |
| April | 395 | 112 | 288 | 17,140 | 3.16 | 3.53 |
| May | 395 | 58 | 120 | 7,379 | 1.32 | 1.52 |
| June | 625 | 10 | 85.0 | 5,058 | .934 | 1.04 |
| July | 18 | 4 | 12.4 | 762 | .136 | .157 |
| August | 10 | 4 | 8.8 | 541 | .097 | .112 |
| September | 10 | 10 | 10.0 | 595 | .110 | .123 |
| October | 18 | 10 | 15.2 | 935 | .167 | .192 |
| November | 10 | 10 | 10.0 | 595 | .110 | .123 |
| December | 75 | 10 | 22.1 | 1,359 | .243 | .280 |
| The year | 15,450 | 4 | 264 | 190,100 | 2.90 | 39.17 |

### PUTA CREEK AT WINTERS, CAL.

This station was established September 26, 1905, by R. S. Hawley. It is located about 450 feet below the Southern Pacific Railroad bridge and about 800 feet southeast of the depot at Winters, Cal.

The channel is straight for about 500 feet above and 700 feet below the cable section. The bed of the stream is composed of coarse gravel and is liable to some change at very high stages, but at ordinary stages it is not subject to much change. The current is sluggish at low water, but is swift during flood stages. There is a growth of willows and cottonwoods with wild grapevines along the banks, but the main portion of the channel is clear.

At very high flood stages the water spreads out over the left bank for about 150 feet, reaching nearly to the foot of the left cable support. At ordinary stages, however, the water remains within the high banks.

Measurements are made during low water by wading at a point about 400 feet above the bridge, but for higher stages a cable and car are used. The cable has a span of 280 feet. For float measurements, a course 250 feet long has been marked off by setting posts painted white, 250 feet above and parallel with the cable. Floats can be dropped from the railroad bridge above and timed from these posts to the cable. The initial point of soundings is a bolt in the trunk of the oak tree to which the cable is fastened on the right bank.

The gage consists of a series of timbers painted white and located under the cable. The first or low-water section is on the right bank, and is nailed vertically to the trunk of a cottonwood tree. It has a range of about 6 feet. The second section is on the left bank and is nailed vertically to the stump of a cottonwood tree. The third section is an inclined rod anchored on the left bank with posts. The fourth section is on an eucalyptus tree on top of left bank. During 1905 the gage was read once each day by Roy Wyatt. Bench marks were established as follows: (1) A standard United States Geological Survey bench mark, located 150 feet south of the depot. Its elevation as marked on the copper plate is 131 feet, 39.23 feet above the datum of the gage. (2) A square-headed bolt in concrete, 3 feet south of the left cable support; elevation, 37.27 feet above the datum of the gage.

*Discharge measurements of Puta Creek at Winters, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| September 12 | W. B. Clapp | 16 | 8.0 | 1.09 | .......... | 8.7 |
| September 26 | Hawley and Lee | 16 | 8.8 | .97 | 4.39 | 8.5 |
| November 15 | R. S. Hawley | 16 | 8.8 | 1.33 | 4.42 | 11.7 |

*Daily gage height, in feet, of Puta Creek at Winters, Cal., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 4.4 | 4.4 | 4.6 | 17 | ........ | 4.4 | 4.45 | 4.55 |
| 2 | ........ | 4.4 | 4.4 | 4.65 | 18 | ........ | 4.4 | 4.45 | 4.6 |
| 3 | ........ | 4.4 | 4.4 | 4.6 | 19 | ........ | 4.4 | 4.45 | 4.6 |
| 4 | ........ | 4.4 | 4.4 | 4.6 | 20 | ........ | 4.4 | 4.45 | 4.6 |
| 5 | ........ | 4.4 | 4.4 | 4.6 | 21 | ........ | 4.4 | 4.45 | 4.6 |
| 6 | ........ | 4.4 | 4.4 | 4.6 | 22 | ........ | 4.4 | 4.45 | 4.6 |
| 7 | ........ | 4.4 | 4.4 | 4.55 | 23 | ........ | 4.4 | 4.5 | 4.6 |
| 8 | ........ | 4.4 | 4.4 | 4.55 | 24 | ........ | 4.4 | 4.5 | 4.6 |
| 9 | ........ | 4.4 | 4.4 | 4.55 | 25 | ........ | 4.4 | 4.5 | 4.6 |
| 10 | ........ | 4.4 | 4.4 | 4.5 | 26 | 4.4 | 4.4 | 4.5 | 4.6 |
| 11 | ........ | 4.4 | 4.4 | 4.5 | 27 | 4.4 | 4.4 | 4.5 | 4.6 |
| 12 | ........ | 4.4 | 4.45 | 4.5 | 28 | 4.4 | 4.4 | 4.5 | 4.6 |
| 13 | ........ | 4.4 | 4.45 | 4.55 | 29 | 4.45 | 4.4 | 4.6 | 4.6 |
| 14 | ........ | 4.4 | 4.45 | 4.55 | 30 | 4.4 | 4.4 | 4.6 | 4.6 |
| 15 | ........ | 4.4 | 4.45 | 4.55 | 31 | ........ | 4.4 | ........ | 4.6 |
| 16 | ........ | 4.4 | 4.45 | 4.55 | | | | | |

## SAN JOAQUIN RIVER.

### DESCRIPTION OF RIVER.

San Joaquin River is divided into two distinct parts. The valley portion forms the central drainage line of San Joaquin Valley, and during the spring is navigable for 100 miles or more. Stanislaus, Tuolumne, Merced, and Kings rivers are the largest streams in this portion of the drainage basin. The waters of Kings, Kaweah, Tule, and Kern rivers, which are located in the portion of San Joaquin Valley lying to the south and east of Fresno, although forming a portion of the drainage of San Joaquin River, seldom reach this stream. Their entire flow, except in extreme flood, is diverted and used for irrigation at points where they emerge from the foothills. The valley is fertile and almost destitute of timber. The mountainous portion of the stream drains the western slope of the Sierra Nevada between the Merced River on the north and Kings River on the south, the crest of its divide reaching an elevation of 13,000 feet in Mount Lyell and an elevation of 14,000 feet in Mount Goddard. There are numerous tributaries in this portion of the drainage basin, many of which have their source in the high elevations. The formation is of granite, which in the upper reaches is bare and sharply marked by glacial action. The middle reaches of the basin are well timbered, the timber diminishing on the lower foothills, which have a covering of brush and grass. The precipitation takes the form of snow on the higher elevations. The fall of the river is rapid, with many favorable locations for power development. There are numerous lakes in the upper reaches of the basin. A storage reservoir has been constructed on North Fork, which will tend to further regulate the flow of the river.

### SAN JOAQUIN RIVER AT HERNDON, CAL.

The gage rod at this station was established by the engineering department of the Southern Pacific Railroad Company in 1879. The old trestle bridge was torn down by the railroad company during 1899 and a new iron structure was erected in its place. A new gage rod, set to the datum of the old gage, was bolted to the western side of the central concrete pier. The bench mark is a nail in a post at the south end of the bridge on the west side, 0.2 foot above the ground, and marked "B. M." It is at an elevation of 24.12 feet above gage datum.

The channel for some distance above and below the bridge is straight, and the water has a uniform velocity. The right bank is high, rocky, and steep. The bed of the stream is composed of small gravel and shifting sand. Because of the continual changes in the cross section, which were increased by a side channel breaking through the gravel pits on the left bank of the river just above the gaging station, meter measurements were discontinued at this station at the end of 1901.

The river stage record for 1905 has been furnished by William Hood, chief engineer of the Southern Pacific Railroad Company. G. G. Nelson was the observer.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Daily gage height, in feet, of San Joaquin River at Herndon, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 3.0 | 3.9 | 4.5 | 7.0 | 6.75 | 6.1 | 3.5 | 3.15 | 2.5 | 2.4 | 2.6 |
| 2 | 3.5 | 3.15 | 4.1 | 4.5 | 6.75 | 6.6 | 6.0 | 3.5 | 3.1 | 2.5 | 2.4 | 2.65 |
| 3 | 3.3 | 4.6 | 4.25 | 4.5 | 6.6 | 6.6 | 5.75 | 3.5 | 3.0 | 2.5 | 2.4 | 2.65 |
| 4 | 3.25 | 4.4 | 4.25 | 4.5 | 6.0 | 6.75 | 6.0 | 3.5 | 3.0 | 2.5 | 2.4 | 2.6 |
| 5 | 3.15 | 4.3 | 4.25 | 5.0 | 5.5 | 6.75 | 6.0 | 3.5 | 2.9 | 2.5 | 2.4 | 2.6 |
| 6 | 3.15 | 4.75 | 4.15 | 5.25 | 5.5 | 6.4 | 5.75 | 3.5 | 2.75 | 2.5 | 2.4 | 2.6 |
| 7 | 3.15 | 4.5 | 4.15 | 5.3 | 5.65 | 6.3 | 5.5 | 3.4 | 2.75 | 2.5 | 2.4 | 2.6 |
| 8 | 3.15 | 4.0 | 4.25 | 5.5 | 5.65 | 7.15 | 5.3 | 3.4 | 2.75 | 2.5 | 2.4 | 2.6 |
| 9 | 3.1 | 3.75 | 4.3 | 6.65 | 6.0 | 7.4 | 5.3 | 3.4 | 2.75 | 2.5 | 2.4 | 2.5 |
| 10 | 3.1 | 3.5 | 4.3 | 5.75 | 5.5 | 7.4 | 5.2 | 3.4 | 2.75 | 2.5 | 2.4 | 2.6 |
| 11 | 3.1 | 3.5 | 4.5 | 5.5 | 5.5 | 7.5 | 5.15 | 3.4 | 2.75 | 2.5 | 2.4 | 2.5 |
| 12 | 3.1 | 3.5 | 4.5 | 5.5 | 5.5 | 8.3 | 5.1 | 3.3 | 2.75 | 2.5 | 2.4 | 2.5 |
| 13 | 3.1 | 3.4 | 4.5 | 5.3 | 5.5 | 8.75 | 5.0 | 3.3 | 2.75 | 2.5 | 2.4 | 2.5 |
| 14 | 3.1 | 3.3 | 7.15 | 4.75 | 5.5 | 8.0 | 4.75 | 3.3 | 2.65 | 2.5 | 2.4 | 2.5 |
| 15 | 3.1 | 3.3 | 5.5 | 4.7 | 6.0 | 8.0 | 4.75 | 3.3 | 2.65 | 2.5 | 2.4 | 2.5 |
| 16 | 3.3 | 3.25 | 5.0 | 5.1 | 7.0 | 7.75 | 4.65 | 3.25 | 2.65 | 2.5 | 2.4 | 2.5 |
| 17 | 3.15 | 3.15 | 5.0 | 5.25 | 8.5 | 8.0 | 4.65 | 3.25 | 2.65 | 2.5 | 2.4 | 2.5 |
| 18 | 3.1 | 3.15 | 5.0 | 5.0 | 8.75 | 8.25 | 4.65 | 3.25 | 2.65 | 2.5 | 2.4 | 2.5 |
| 19 | 3.0 | 3.15 | 5.0 | 5.0 | 9.65 | 8.75 | 4.65 | 3.25 | 2.65 | 2.5 | 2.4 | 2.5 |
| 20 | 3.0 | 3.15 | 6.5 | 5.0 | 8.25 | 8.3 | 4.5 | 3.25 | 2.65 | 2.5 | 2.4 | 2.6 |
| 21 | 3.0 | 3.15 | 5.0 | 4.75 | 8.6 | 7.75 | 4.5 | 3.25 | 2.65 | 2.5 | 2.4 | 2.75 |
| 22 | 3.0 | 3.15 | 5.0 | 5.0 | 8.25 | 8.0 | 4.5 | 3.25 | 2.65 | 2.5 | 2.4 | 2.75 |
| 23 | 3.0 | 3.15 | 5.0 | 5.0 | 8.3 | 7.5 | 4.5 | 3.15 | 2.65 | 2.5 | 2.4 | 2.75 |
| 24 | 3.0 | 3.15 | 5.0 | 5.0 | 8.1 | 7.15 | 4.3 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 25 | 3.0 | 3.15 | 5.0 | 5.0 | 8.25 | 6.5 | 4.3 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 26 | 3.0 | 3.15 | 5.0 | 5.5 | 8.5 | 6.65 | 4.3 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 27 | 3.0 | 3.15 | 5.25 | 5.5 | 8.3 | 6.5 | 4.25 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 28 | 3.0 | 3.15 | 5.0 | 6.0 | 7.65 | 6.5 | 4.0 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 29 | 3.0 | ....... | 5.0 | 6.0 | 7.65 | 6.5 | 3.75 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 30 | 3.0 | ....... | 4.75 | 6.15 | 6.6 | 6.6 | 3.6 | 3.15 | 2.6 | 2.4 | 2.4 | 2.75 |
| 31 | 3.0 | ....... | 4.7 | ....... | 6.75 | ....... | 3.6 | 3.15 | ....... | 2.4 | 2.6 | 2.65 |

NOTE.—Gage heights reduced to feet and tenths from feet and inches as furnished by Southern Pacific Railroad Company.

## MISCELLANEOUS MEASUREMENTS IN SAN JOAQUIN RIVER DRAINAGE BASIN.

*Pitman Creek.*—This stream is tributary to the San Joaquin River through Big Creek An estimate was made of the discharge below the mouth of Tamarack Creek on September 2, 1905, by R. S. Hawley.

Discharge, 1.5 second-feet.

*Home Camp Creek.*—This stream is tributary to the San Joaquin River through Big Creek, which it enters at Home Camp meadow. A measurement was made on this creek on September 2, 1905, 100 feet above its mouth, by R. S. Hawley.

Width, 3.0 feet; area, 0.8 square foot; mean velocity, 1.12 feet per second; discharge, 0.90 second-foot.

*Big Creek.*—This stream is tributary to San Joaquin River from the east. A measurement was made 100 feet above the mouth of Home Camp Creek on September 2, 1905, by R. S. Hawley.

Width, 4.5 feet; area, 1.9 square feet; mean velocity, 2.53 feet per second; discharge, 4.8 second-feet.

Discharge below the mouth of Home Camp Creek was 5.7 second-feet.

*Small Creek.*—This is a small creek which enters the South Fork of the San Joaquin from the south at Mono crossing. A measurement was made at the Mono trail crossing about 1,000 feet above its mouth on September 4, 1905, by R. S. Hawley.

Width, 2.8 feet; area, 1.1 square feet; mean velocity, 1.18 feet per second; discharge, 1.3 second-feet.

*South Fork of San Joaquin River.*—This is the principal tributary of the San Joaquin River from the south. A measurement was made September 4, 1905, at the Mono crossing by R. S. Hawley.

Width, 60 feet; area, 94 square feet; mean velocity, 1.11 feet per second; discharge, 104 second-feet.

*Mono Creek.*—This stream is tributary to South Fork of San Joaquin River from the east. A measurement was made at the Mono Trail crossing, about 2 miles above its mouth, on September 4, 1905, by R. S. Hawley.

Width, 44.5 feet; area, 37 square feet; mean velocity, 1.17 feet per second; discharge, 43 second-feet.

*Fish Creek.*—This stream is the principal tributary of the Middle Fork of the San Joaquin from the south about 10 miles above the junction of the Middle and South forks. A measurement was made on September 6, 1905, at the trail crossing, about 3 miles above its mouth, by R. S. Hawley.

Width, 29 feet; area, 36 square feet; mean velocity, 1.42 feet per second; discharge, 51 second-feet.

*Middle Fork of San Joaquin River.*—This stream drains the northeastern portion of the San Joaquin watershed. A measurement was made on September 6, 1905, at the Devils Post Pile at the trail crossing by R. S. Hawley.

Width, 42 feet; area, 41 square feet; mean velocity, 0.90 foot per second; discharge, 37 second-feet.

*Reds Creek.*—This stream enters Middle Fork of San Joaquin River one-half mile below the Devils Post Pile. A measurement was made September 6, 1905, at the Mammoth trail crossing, one-fourth mile above its mouth, by R. S. Hawley.

Width, 9 feet; area, 4.2 square feet; mean velocity, 0.93 foot per second; discharge, 3.9 second-feet.

*King Creek.*—This stream enters Middle Fork of San Joaquin River near Rainbow Falls. An estimate was made of the discharge one mile above its mouth, at Mammoth trail crossing, on September 7, 1905, by R. S. Hawley.

Discharge, 3.5 second-feet.

*Mugler Creek.*—This stream enters the San Joaquin River from the north. On September 7, 1905, an estimate of the discharge was made at the trail crossing, one-half mile below Mugler Meadow, by R. S. Hawley.

Discharge, 3.0 second-feet.

*Stevenson Creek.*—This stream enters the San Joaquin River 4 miles northwest of Shaver post-office. A measurement was made one-fourth mile above the head of Shaver Lake on September 2, 1905, by R. S. Hawley.

Width, 8 feet; area, 3.2 square feet; mean velocity, 1.22 feet per second; discharge, 3.9 second-feet.

*North Fork of the San Joaquin River.*—This stream enters the San Joaquin River 4 miles below the junction of the Middle and South forks. A measurement was made on September 7, 1905, 150 feet below the bridge, at the trail crossing, 3 miles above its mouth.

Width, 31 feet; area, 27 square feet; mean velocity, 1.33 feet per second; discharge, 36 second-feet.

*North Fork of Willow Creek.*—This stream enters the San Joaquin from the north. A measurement was made on September 9, 1905, at "The Pines," 1½ miles above reservoir dam, by R. S. Hawley.

Width, 7 feet; area, 3.6 square feet; mean velocity, 1.19 feet per second; discharge, 4.3 second-feet.

*San Joaquin River at the San Joaquin power house.*—A measurement was made on this stream on September 9, 1905, one-half mile below the power house, by R. S. Hawley. This measurement includes practically the total flow from the whole drainage area of the San Joaquin River about this point.

Width, 148.5 feet; area, 226 square feet; mean velocity, 1.37 feet per second; discharge, 310 second-feet.

## KERN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Kern River drains 2,345 square miles of the western slope of the Sierra Nevada at its extreme southern limits. This drainage basin is the largest of any stream discharging into the San Joaquin Valley, it having an area 600 square miles greater than that of the Kings River. It has its source in the highest elevations of the Sierra Nevada, draining the western and southern slopes of Mount Whitney and numerous other high granite peaks grouped about it, which reach elevations of over 14,000 feet. Its general direction is south for about 65 miles when it turns and flows in a southwesterly direction, discharging into the San Joaquin Valley east of Bakersfield, Cal. Extending, as it does in its upper reaches, for some distance parallel with the Sierra Nevada, it receives waters not only from the main crest on the east, but also from a somewhat lower divide on the west behind the basins of the Kaweah and Tule rivers. It has numerous tributaries, the principal ones entering from the east, which drain the higher elevations of the main crest of the Sierra Nevada. The topography is extremely rough and broken in the upper reaches of this basin, becoming less rugged in the middle portion in the vicinity of Kernville, where there is quite an extensive valley with considerable cultivated land; below this point the stream enters a rough canyon, finally discharging into the flat country of the San Joaquin Valley. The entire flow, except during extreme flood stages, is diverted and used for irrigation at points where streams emerge from the foothills.

The formation is of granite, which, above the 10,000-foot contour, is practically bare of timber growth. Between elevations of 3,000 and 10,000 feet there is a good depth of soil, with timber and brush covering; the lower reaches have a light covering of brush and grass.

There are several lakes and marshes scattered throughout this basin, but they are less numerous than in the basins farther to the north. Several power plants are located on this stream, none of which, however, receive water from storage reservoirs, the diversions being made from the natural flow of the river and again returned to the river channel. The precipitation is very light throughout this basin, with the possible exception of the high elevations surrounding Mount Whitney, where the snow remains through the summer months.

### KERN RIVER NEAR BAKERSFIELD, CAL.

This station, established in 1893 by Walter James, chief engineer of the Kern County Land Company, is located at what is known as "first point of measurement," 5 miles above Bakersfield and at the mouth of the canyon of the river.

Regular meter measurements are taken, and an automatic gage records daily fluctuations of the river heights. A. K. Warren, the engineer in charge of this work for the Kern County Land Company, attends to the discharge measurements with accuracy and precision and furnishes the Geological Survey with the final results.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Daily discharge, in second-feet, of Kern River near Bakersfield, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 280 | 305 | 435 | 799 | 1,700 | 1,953 | 1,520 | 427 | 233 | 205 | 230 | 262 |
| 2 | 285 | 326 | 458 | 848 | 1,713 | 1,979 | 1,422 | 413 | 229 | 226 | 227 | 281 |
| 3 | 272 | 435 | 480 | 934 | 1,743 | 1,932 | 1,313 | 403 | 224 | 227 | 221 | 276 |
| 4 | 278 | 486 | 500 | 997 | 1,633 | 1,931 | 1,226 | 394 | 213 | 208 | 218 | 285 |
| 5 | 290 | 517 | 512 | 1,047 | 1,542 | 1,919 | 1,215 | 376 | 216 | 196 | 215 | 277 |
| 6 | 281 | 503 | 530 | 1,070 | 1,517 | 1,879 | 1,218 | 362 | 215 | 190 | 216 | 271 |
| 7 | 269 | 452 | 545 | 1,103 | 1,453 | 1,997 | 1,171 | 345 | 217 | 181 | 231 | 267 |
| 8 | 272 | 391 | 593 | 1,138 | 1,531 | 2,154 | 1,157 | 356 | 220 | 175 | 217 | 275 |
| 9 | 270 | 364 | 616 | 1,185 | 1,461 | 2,150 | 1,115 | 358 | 218 | 176 | 225 | 278 |
| 10 | 276 | 365 | 609 | 1,119 | 1,418 | 2,066 | 1,130 | 351 | 207 | 186 | 227 | 284 |
| 11 | 280 | 351 | 613 | 1,186 | 1,367 | 2,200 | 1,125 | 349 | 202 | 192 | 230 | 264 |
| 12 | 272 | 338 | 631 | 1,180 | 1,300 | 2,567 | 1,092 | 349 | 208 | 199 | 232 | 278 |
| 13 | 266 | 334 | 785 | 1,052 | 1,298 | 2,923 | 1,038 | 352 | 218 | 206 | 233 | 265 |
| 14 | 246 | 317 | 1,154 | 971 | 1,317 | 2,978 | 958 | 352 | 225 | 206 | 228 | 241 |
| 15 | 255 | 317 | 974 | 952 | 1,425 | 3,039 | 886 | 345 | 221 | 202 | 223 | 244 |
| 16 | 255 | 361 | 996 | 991 | 1,649 | 2,933 | 799 | 338 | 218 | 199 | 234 | 240 |
| 17 | 260 | 398 | 1,143 | 995 | 1,949 | 2,948 | 748 | 327 | 215 | 203 | 240 | 238 |
| 18 | 269 | 434 | 1,140 | 1,052 | 2,312 | 2,747 | 717 | 319 | 215 | 194 | 257 | 246 |
| 19 | 277 | 417 | 1,009 | 1,121 | 2,359 | 2,569 | 665 | 318 | 208 | 198 | 263 | 259 |
| 20 | 273 | 413 | 1,309 | 1,058 | 2,528 | 2,555 | 628 | 308 | 203 | 215 | 262 | 266 |
| 21 | 305 | 401 | 1,073 | 992 | 2,549 | 2,547 | 634 | 286 | 197 | 218 | 247 | 285 |
| 22 | 329 | 386 | 957 | 964 | 2,625 | 2,539 | 597 | 279 | 194 | 217 | 243 | 272 |
| 23 | 343 | 390 | 888 | 920 | 2,558 | 2,408 | 578 | 267 | 195 | 221 | 239 | 255 |
| 24 | 311 | 397 | 871 | 895 | 2,412 | 2,154 | 558 | 269 | 196 | 230 | 227 | 233 |
| 25 | 301 | 410 | 900 | 936 | 2,456 | 1,835 | 557 | 286 | 201 | 226 | 237 | 221 |
| 26 | 298 | 420 | 929 | 1,033 | 2,560 | 1,690 | 548 | 285 | 204 | 218 | 239 | 239 |
| 27 | 281 | 432 | 999 | 1,070 | 2,598 | 1,685 | 536 | 282 | 214 | 217 | 253 | 255 |
| 28 | 276 | 434 | 978 | 1,067 | 2,378 | 1,617 | 532 | 271 | 200 | 221 | 259 | 262 |
| 29 | 271 | ...... | 919 | 1,157 | 2,120 | 1,584 | 520 | 270 | 205 | 222 | 263 | 271 |
| 30 | 276 | ...... | 1,051 | 1,451 | 1,962 | 1,563 | 488 | 265 | 205 | 224 | 245 | 255 |
| 31 | 284 | ...... | 913 | ........ | 1,930 | ........ | 451 | 250 | ...... | 226 | ...... | 257 |

*Estimated monthly discharge of Kern River near Bakersfield, Cal., for 1905.*

[Drainage area, 2,345 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 343 | 246 | 281 | 17,280 | 0.120 | 0.138 |
| February | 517 | 305 | 396 | 21,990 | .169 | .176 |
| March | 1,309 | 435 | 823 | 50,600 | .351 | .405 |
| April | 1,451 | 799 | 1,043 | 62,060 | .445 | .496 |
| May | 2,625 | 1,298 | 1,915 | 117,800 | .817 | .942 |
| June | 3,039 | 1,563 | 2,235 | 133,000 | .953 | 1.06 |
| July | 1,520 | 451 | 876 | 53,860 | .374 | .431 |
| August | 427 | 250 | 327 | 20,110 | .139 | .160 |
| September | 233 | 194 | 211 | 12,560 | .090 | .100 |
| October | 230 | 175 | 207 | 12,730 | .088 | .101 |
| November | 263 | 215 | 236 | 14,040 | .101 | .113 |
| December | 285 | 221 | 261 | 16,050 | .111 | .128 |
| The year | 3,039 | 175 | 734 | 532,100 | .313 | 4.25 |

## TULE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Tule River rises in the Sierra Nevada, and drains the country between the Kaweah River on the north and the Kern River on the south and east. Its drainage area is much less than that of the Kaweah River, although of the same general character. It has numerous small tributaries, few of which have their source at elevations above 8,000 feet. Its drainage basin does not extend back to the main divide, being cut off by the Kern River, which reaches to the north and drains the higher portion of Sierra Nevada to the east of Tule River. There is good timber and brush covering on the higher and middle elevations, with grass and scattering timber on the lower elevations, where the soil is extensively cultivated. Below the gaging station the water is diverted by several canals and used for the irrigation of land in the vicinity of Portersville, which is especially adapted for the raising of citrus fruits, such as oranges and lemons. During the flood period the water discharges through an old channel, and either sinks in the sand or finds its way to the old bed of Tulare Lake.

The mean precipitation in this watershed is probably not more than 20 inches, and falls principally in the form of rain.

### TULE RIVER NEAR PORTERSVILLE, CAL.

This station was established April 8, 1901. It is located about 8 miles east of Portersville near the McFarland ranch, 100 feet below wagon bridge and about 1 mile above the mouth of the South Fork of Tule River.

The channel is straight for 200 feet above and below the cable section. The right bank is high and not subject to overflow. The left bank is subject to overflow at flood stages. The bed of the stream is composed of gravel, with some large rocks, but is not subject to much change.

Discharge measurements during medium and high water are made from a car and cable; at low water measurements are made by wading.

The gage is a staff in two sections on the right bank under the cable The lower section is inclined and fastened to posts set in the ground. The higher section is vertical and nailed to the tree through which the cable passes. During 1905 the gage was read by Adah

McFarland. Bench marks were established as follows: (1) A cross on the top of a bowlder on the right bank of the river between the cable and the bridge; elevation, 13.10 feet. (2) A point marked with white paint on a dark granite bowlder 55 feet south of the rock pier of the bridge; elevation, 10.05 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Tule River near Portersville, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 22 | F. R. S. Buttemer | 71 | 107 | 2.05 | 2.50 | 219 |
| May 19 | R. S. Hawley | 77 | 152 | 2.34 | 3.00 | 355 |
| June 13 | do | 69 | 97 | 1.68 | 2.27 | 163 |
| July 26 | do | 33 | 26 | .96 | 1.16 | 25 |
| September 18 | C. H. Lee | 26 | 17 | .58 | .92 | 10 |
| September 26 | Clapp and Holley | 24 | 16 | .50 | .91 | 8.0 |
| October 25 | Hawley and Lee | 30 | 22 | .70 | 1.10 | 15.5 |

*Daily gage height, in feet, of Tule River near Portersville, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 1.45 | 1.7 | 2.3 | 2.5 | 2.55 | 1.7 | 1.05 | 0.9 | 1.1 | 1.05 | 1.9 |
| 2 | 1.7 | 2.30 | 1.7 | 2.4 | 3.0 | 2.55 | 1.7 | 1.05 | .9 | 1.05 | 1.1 | 1.85 |
| 3 | 1.65 | 2.0 | 1.75 | 2.5 | 2.9 | 2.5 | 1.65 | 1.05 | .9 | 1.05 | 1.1 | 1.85 |
| 4 | 1.6 | 2.0 | 1.75 | 2.6 | 2.8 | 2.45 | 1.6 | 1.05 | .9 | 1.0 | 1.1 | 1.8 |
| 5 | 1.6 | 1.9 | 1.75 | 2.55 | 2.5 | 2.45 | 1.55 | 1.05 | .9 | 1.0 | 1.1 | 1.8 |
| 6 | 1.6 | 1.8 | 1.8 | 2.55 | 2.5 | 2.45 | 1.5 | 1.0 | .9 | 1.0 | 1.1 | 1.8 |
| 7 | 1.55 | 1.75 | 1.8 | 2.55 | 3.05 | 2.4 | 1.45 | 1.0 | .9 | 1.0 | 1.1 | 1.8 |
| 8 | 1.55 | 1.7 | 1.8 | 2.5 | 3.2 | 2.35 | 1.4 | 1.0 | .9 | 1.0 | 1.15 | 1.8 |
| 9 | 1.5 | 1.65 | 1.75 | 2.5 | 2.95 | 2.35 | 1.4 | 1.0 | .9 | 1.05 | 1.15 | 1.8 |
| 10 | 1.5 | 1.6 | 1.75 | 2.4 | 2.85 | 2.3 | 1.4 | 1.0 | .95 | 1.05 | 1.15 | 1.8 |
| 11 | 1.5 | 1.6 | 1.7 | 2.35 | 2.8 | 2.3 | 1.4 | 1.0 | .95 | 1.0 | 1.15 | 1.8 |
| 12 | 1.45 | 1.6 | 1.75 | 2.3 | 2.75 | 2.4 | 1.35 | .95 | .95 | 1.0 | 1.15 | 1.8 |
| 13 | 1.45 | 1.6 | 3.1 | 2.35 | 2.7 | 2.35 | 1.35 | .95 | .95 | .95 | 1.15 | 1.8 |
| 14 | 1.4 | 1.6 | 2.8 | 2.35 | 2.9 | 2.3 | 1.3 | .95 | 1.0 | 1.0 | 1.15 | 1.8 |
| 15 | 1.4 | 1.7 | 2.6 | 2.4 | 3.0 | 2.25 | 1.3 | .95 | .95 | 1.0 | 1.2 | 1.8 |
| 16 | 1.4 | 1.75 | 3.0 | 2.35 | 3.2 | 2.25 | 1.3 | .95 | .95 | 1.0 | 1.2 | 1.8 |
| 17 | 1.4 | 1.75 | 3.0 | 2.3 | 3.3 | 2.1 | 1.25 | .95 | .95 | 1.0 | 1.3 | 1.8 |
| 18 | 1.4 | 1.8 | 2.9 | 2.3 | 3.1 | 2.0 | 1.25 | .95 | .95 | 1.0 | 1.3 | 1.9 |
| 19 | 1.4 | 1.8 | 4.1 | 2.5 | 3.0 | 1.95 | 1.2 | .95 | .95 | 1.0 | 1.3 | 1.9 |
| 20 | 1.4 | 1.75 | 3.7 | 2.45 | 3.0 | 1.9 | 1.2 | .95 | .95 | 1.0 | 1.7 | 1.9 |
| 21 | 1.6 | 1.75 | 3.5 | 2.45 | 2.95 | 1.85 | 1.2 | .95 | .95 | 1.0 | 1.7 | 1.9 |
| 22 | 1.6 | 1.75 | 3.1 | 2.4 | 2.8 | 1.8 | 1.15 | .95 | .95 | 1.0 | 1.65 | 1.9 |
| 23 | 1.5 | 1.7 | 2.8 | 2.4 | 2.7 | 1.8 | 1.15 | .95 | .95 | 1.0 | 1.65 | 1.9 |
| 24 | 1.5 | 1.7 | 2.5 | 2.35 | 2.75 | 1.8 | 1.1 | .95 | .95 | 1.0 | 1.65 | 1.85 |
| 25 | 1.5 | 1.7 | 2.3 | 2.4 | 2.8 | 1.9 | 1.1 | .95 | .95 | 1.0 | 1.6 | 1.85 |
| 26 | 1.5 | 1.7 | 2.3 | 2.4 | 2.8 | 1.85 | 1.15 | .95 | .95 | 1.0 | 1.6 | 1.9 |
| 27 | 1.5 | 1.7 | 2.3 | 2.45 | 2.8 | 1.85 | 1.1 | .95 | .95 | 1.0 | 2.1 | 2.0 |
| 28 | 1.5 | 1.7 | 2.25 | 2.5 | 2.75 | 1.8 | 1.1 | .9 | 1.0 | 1.0 | 1.95 | 2.0 |
| 29 | 1.5 | ........ | 2.9 | 2.6 | 2.7 | 1.8 | 1.15 | .9 | 1.0 | 1.0 | 1.85 | 2.1 |
| 30 | 1.45 | ........ | 2.4 | 2.7 | 2.65 | 1.75 | 1.05 | .9 | 1.0 | 1.05 | 1.9 | 2.1 |
| 31 | 1.4 | ........ | 2.3 | ........ | 2.6 | ........ | 1.05 | .9 | ........ | 1.05 | ........ | 2.1 |

*Station rating table for Tule River near Portersville, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.90 | 7 | 1.80 | 82 | 2.70 | 270 | 3.60 | 581 |
| 1.00 | 12 | 1.90 | 98 | 2.80 | 297 | 3.70 | 626 |
| 1.10 | 18 | 2.00 | 115 | 2.90 | 325 | 3.80 | 672 |
| 1.20 | 24 | 2.10 | 133 | 3.00 | 355 | 3.90 | 720 |
| 1.30 | 31 | 2.20 | 152 | 3.10 | 386 | 4.00 | 770 |
| 1.40 | 38 | 2.30 | 173 | 3.20 | 419 | 4.10 | 822 |
| 1.50 | 46 | 2.40 | 195 | 3.30 | 455 | | |
| 1.60 | 56 | 2.50 | 219 | 3.40 | 494 | | |
| 1.70 | 68 | 2.60 | 244 | 3.50 | 537 | | |

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined between gage heights 0.9 foot and 3 feet.

*Estimated monthly discharge of Tule River near Portersville, Cal., for 1905.*

[Drainage area, 437 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 68 | 38 | 47.4 | 2,914 | 0.108 | 0.124 |
| February | 173 | 42 | 75.9 | 4,215 | .174 | .181 |
| March | 822 | 68 | 230 | 14,140 | .526 | .606 |
| April | 270 | 173 | 205 | 12,200 | .469 | .523 |
| May | 455 | 219 | 313 | 19,250 | .716 | .826 |
| June | 232 | 75 | 146 | 8,688 | .334 | .373 |
| July | 68 | 15 | 32.9 | 2,023 | .075 | .086 |
| August | 15 | 7 | 9.8 | 603 | .022 | .025 |
| September | 12 | 7 | 8.2 | 488 | .019 | .021 |
| October | 18 | 8 | 12.6 | 775 | .029 | .033 |
| November | 133 | 15 | 42.4 | 2,523 | .097 | .108 |
| December | 133 | 82 | 94.2 | 5,792 | .216 | .249 |
| The year | 822 | 7 | 101 | 73,610 | .232 | 3.16 |

### MISCELLANEOUS MEASUREMENTS IN TULE RIVER DRAINAGE BASIN.

*South Fork of Tule River near Success, Cal.*—The following measurements were made at a point one-half mile above junction of South Fork with Main Tule River.

May 19: Width, 28 feet; area, 32 feet; mean velocity, 2.86 feet per second; discharge, 90 second-feet.

September 26, stream dry.

*North Fork of Tule River near Springville, Cal.*—A measurement was made September 26 at road crossing one-half mile above junction with Middle Fork of Kings River.

Water standing in pools; discharge, 00 second-feet.

*Middle Fork of Tule River near Springville, Cal.*—This stream is the principal tributary of Kaweah River and furnishes practically all the water of this river during low-water flow. A measurement was made September 27 one-fourth mile above clubhouse and 2 miles above the town of Springville.

Width, 33.5 feet; area, 36 square feet; mean velocity, 0.64 foot per second; discharge, 23 second-feet.

*South Fork of Middle Fork of Tule River near Springville, Cal.*—This stream is a tributary to Middle Fork of Kaweah River. A measurement was made September 27 at a point 100 feet above its junction with Middle Fork.

Width, 8.4 feet; area, 4.0 square feet; mean velocity, 2.20 feet per second; discharge, 8.8 second-feet.

*North Fork of Middle Fork of Tule River near Springville, Cal.*—This stream is tributary to Middle Fork of Kaweah River. A measurement was made September 27 100 feet above its junction with Middle Fork.

Width, 7.9 feet; area, 5.9 square feet; mean velocity, 2.19 feet per second; discharge, 12.9 second-feet.

## KAWEAH RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Kaweah River drains the western slope of the Sierra Nevada between the basins of Kings River on the north and Kern and Tule rivers on the south. This is an important stream, but its watershed is only about one-third that of Kings River and is much less elevated and snow covered than those of the Kings and Kern rivers. It has a number of tributaries which have their source in numerous lakes and meadows on the higher elevations. The formation is of granite and similar in every way to that in the Kings River basin. The greater part of the area of 619 square miles above the gaging station is well covered with brush and timber. In this basin is situated the Sequoia National Park, where the largest grove of big trees (*Sequoia gigantea*) of the Sierra Nevada is found. This grove is known as the "Giant Forest," and is one of the many points of interest of the Sierra Nevadas. There are two power plants on this stream owned by the Mount Whitney Power Company, which divert water from the Middle and East forks. This company has constructed several small storage reservoirs on the upper reaches of this basin. This has been done by building low dams at the outlet of some of the larger lakes. The stored water is held back for use during the low-water flow of the stream, and is of great benefit to the irrigators in the valley during the late summer months. About 6 miles below the gaging station the river leaves the foothills and flows across San Joaquin Valley in a general southwesterly direction to the old bed of Tulare Lake. After it leaves the foothills many canals divert water for the purpose of irrigating land in Tulare County, which is especially adapted to the raising of fruits.

The mean annual precipitation in the basin above the gaging station is from 20 to 40 inches, which falls in the form of snow over probably one-half the area.

### KAWEAH RIVER BELOW THREE RIVERS, CAL.

This station was established April 29, 1903, by W. H. Stearns. It is located at a point three-fourths of a mile below the confluence of the North, Middle, and South forks. It is 10 miles from the Southern Pacific Railroad station at Lemon Cove, Tulare County, Cal., and one-fourth of a mile west of the wagon road from Exeter to Three Rivers.

The channel is straight for 400 feet above and below the station. The current is swift at high stages, but sluggish at low water. There are rapids about 400 feet above and 500 feet below the cable. The right bank is low and subject to overflow at high stages. The left bank is high enough to be above overflow. There are willow trees along the water's edge on both banks, and a line of willows, sycamores, and cottonwoods back from the water's edge on the left bank. The bed of the stream is composed of sand, gravel, and large bowlders. The section is probably permanent.

Discharge measurements are made from a cable and car. The initial point for soundings is a sycamore tree on the left bank of the stream, to which the cable is fastened.

The low-water gage is an inclined timber on the left bank. The high-water gage is a timber securely nailed to a willow tree on the left bank. During 1905 the gage was read by J. O. Carter. Bench marks were established as follows: (1) A point marked "B. M." with black paint on a large rock 10 feet upstream from the tree to which the cable is attached;

elevation, 13.95 feet. (2) A point on rock marked with white paint 7 feet upstream from the 75-foot mark on the cable; elevation, 15.89 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Kaweah River below Three Rivers, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 18 | F. R. S. Buttemer | 157 | 464 | 1.24 | 5.94 | 577 |
| March 20 | do | 160 | 526 | 1.55 | 6.26 | 815 |
| May 20 | R. S. Hawley | 175 | 647 | 2.70 | 7.25 | 1,746 |
| June 14 | do | 170 | 653 | 2.27 | 7.00 | 1,480 |
| July 25 | do | 140 | 306 | 0.44 | 4.83 | 136 |
| September 17 | C. H. Lee | 29 | 44 | 0.73 | 4.25 | 32 |
| October 24 [a] | Hawley and Lee | 56 | 61 | 0.80 | 4.30 | 49 |

[a] Section 400 feet below cable.

*Daily gage height, in feet, of Kaweah River below Three Rivers, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.9 | 4.9 | 5.4 | 5.8 | 6.8 | 7.05 | 6.05 | 4.65 | 4.3 | 4.3 | 4.2 | 4.6 |
| 2 | 4.85 | 5.95 | 5.45 | 5.9 | 6.7 | 7.0 | 6.0 | 4.65 | 4.3 | 4.35 | 4.2 | 4.6 |
| 3 | 4.8 | 5.4 | 5.5 | 6.0 | 6.55 | 7.0 | 5.9 | 4.65 | 4.2 | 4.3 | 4.25 | 4.55 |
| 4 | 4.75 | 5.2 | 5.5 | 6.1 | 6.4 | 7.3 | 5.9 | 4.65 | 4.3 | 4.25 | 4.25 | 4.5 |
| 5 | 4.7 | 5.65 | 5.5 | 6.2 | 6.3 | 6.8 | 5.8 | 4.6 | 4.3 | 4.3 | 4.25 | 4.6 |
| 6 | 4.7 | 5.2 | 5.4 | 6.2 | 6.4 | 7.45 | 5.75 | 4.6 | 4.3 | 4.2 | 4.3 | 4.5 |
| 7 | 4.7 | 5.15 | 5.45 | 6.3 | 6.55 | 7.05 | 5.75 | 4.6 | 4.3 | 4.25 | 4.3 | 4.6 |
| 8 | 4.7 | 5.15 | 5.5 | 6.25 | 6.6 | 6.95 | 5.7 | 4.55 | 4.3 | 4.2 | 4.3 | 4.55 |
| 9 | 4.7 | 5.15 | 5.5 | 6.25 | 6.5 | 6.8 | 5.7 | 4.55 | 4.3 | 4.3 | 4.3 | 4.56 |
| 10 | 4.7 | 5.0 | 5.45 | 6.2 | 6.35 | 7.05 | 5.65 | 4.55 | 4.2 | 4.25 | 4.3 | 4.55 |
| 11 | 4.7 | 5.1 | 5.55 | 6.15 | 6.3 | 7.15 | 5.6 | 4.55 | 4.25 | 4.2 | 4.3 | 4.5 |
| 12 | 4.6 | 5.0 | [a] 5.6 | 6.0 | 6.3 | 7.35 | 5.5 | 4.55 | 4.25 | 4.2 | 4.25 | 4.5 |
| 13 | 4.7 | 5.1 | 6.9 | 6.0 | 6.35 | 7.25 | 5.4 | 4.55 | 4.25 | 4.2 | 4.25 | 4.5 |
| 14 | 4.6 | 5.0 | 5.9 | 6.0 | 6.55 | 7.15 | 5.3 | 4.6 | 4.25 | 4.2 | 4.3 | 4.55 |
| 15 | 4.6 | 5.0 | 5.8 | 6.1 | 6.9 | 7.15 | 5.25 | 4.6 | 4.25 | 4.2 | 4.25 | 4.55 |
| 16 | 4.65 | 5.45 | 6.1 | 6.2 | 7.3 | 7.15 | 5.2 | 4.6 | 4.25 | 4.25 | 4.3 | 4.55 |
| 17 | 4.7 | 5.35 | 6.0 | 6.2 | 7.4 | 7.1 | 5.2 | 4.45 | 4.2 | 4.25 | 4.3 | 4.5 |
| 18 | 4.65 | 5.65 | 5.95 | 6.35 | 7.35 | 7.0 | 5.1 | 4.4 | 4.25 | [a] 4.25 | 4.4 | 4.5 |
| 19 | 4.7 | 5.3 | 7.0 | 6.3 | 7.4 | 6.95 | 5.1 | 4.4 | 4.2 | 4.25 | 4.3 | 4.55 |
| 20 | 4.7 | 5.2 | 6.2 | 6.25 | 7.3 | 6.9 | 5.0 | 4.35 | 4.25 | 4.25 | 4.45 | 4.6 |
| 21 | 4.95 | 5.2 | 6.1 | 6.15 | 7.45 | 6.8 | 5.0 | 4.4 | 4.25 | 4.2 | 4.5 | 4.6 |
| 22 | 4.95 | 5.15 | 5.9 | 6.15 | 7.4 | 6.7 | 5.0 | 4.4 | 4.2 | 4.2 | 4.4 | 4.5 |
| 23 | 4.8 | 5.1 | [a] 5.9 | 6.15 | 7.3 | 6.6 | 4.95 | 4.4 | 4.2 | 4.2 | 4.4 | 4.5 |
| 24 | 4.8 | 5.15 | 5.9 | 6.2 | 7.4 | 6.4 | 4.9 | 4.4 | 4.2 | 4.25 | 4.4 | 4.5 |
| 25 | 4.75 | 5.2 | 5.9 | 6.35 | 7.5 | 6.30 | 4.9 | 4.4 | 4.2 | 4.3 | 4.4 | 4.6 |
| 26 | 4.7 | 5.2 | 6.1 | 6.3 | 7.35 | 6.35 | 4.85 | 4.4 | 4.2 | 4.25 | 4.4 | 4.5 |
| 27 | 4.7 | 5.1 | 6.0 | 6.35 | 7.1 | 6.0 | 4.85 | 4.4 | 4.2 | 4.25 | 4.55 | 4.5 |
| 28 | 4.7 | 5.4 | 5.85 | 6.5 | 6.9 | 6.2 | 4.8 | 4.35 | 4.2 | 4.2 | 4.6 | 4.6 |
| 29 | 4.7 | ....... | 6.2 | 6.75 | 6.75 | 6.15 | 4.7 | 4.3 | 4.4 | 4.2 | 4.6 | 4.6 |
| 30 | 4.7 | ....... | 5.9 | 6.85 | 6.85 | 6.15 | 4.7 | 4.3 | 4.45 | 4.25 | 4.6 | 4.6 |
| 31 | 4.7 | ....... | 5.7 | ....... | 6.95 | ....... | 4.7 | 4.25 | ....... | 4.2 | ....... | 4.65 |

*Station rating table for Kaweah River below Three Rivers, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.20 | 40 | 5.10 | 210 | 6.00 | 625 | 6.90 | 1,375 |
| 4.30 | 49 | 5.20 | 240 | 6.10 | 690 | 7.00 | 1,480 |
| 4.40 | 61 | 5.30 | 274 | 6.20 | 760 | 7.10 | 1,590 |
| 4.50 | 75 | 5.40 | 312 | 6.30 | 835 | 7.20 | 1,700 |
| 4.60 | 91 | 5.50 | 350 | 6.40 | 915 | 7.30 | 1,815 |
| 4.70 | 109 | 5.60 | 395 | 6.50 | 1,000 | 7.40 | 1,935 |
| 4.80 | 130 | 5.70 | 445 | 6.60 | 1,090 | 7.50 | 2,060 |
| 4.90 | 154 | 5.80 | 500 | 6.70 | 1,180 | | |
| 5.00 | 180 | 5.90 | 560 | 6.80 | 1,275 | | |

NOTE.—The above table is based on seven discharge measurements made during 1905. It is well defined throughout.

*Estimated monthly discharge of Kaweah River below Three Rivers, Cal., for 1905.*

[Drainage area, 520 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 167 | 91 | 116 | 7,133 | 0.223 | 0.257 |
| February | 592 | 154 | 258 | 14,330 | .496 | .516 |
| March | 1,480 | 312 | 553 | 34,000 | 1.06 | 1.22 |
| April | 1,325 | 500 | 783 | 46,590 | 1.51 | 1.68 |
| May | 2,060 | 835 | 1,386 | 85,220 | 2.67 | 3.08 |
| June | 1,998 | 625 | 1,348 | 80,210 | 2.59 | 2.89 |
| July | 658 | 109 | 303 | 18,630 | .583 | .672 |
| August | 100 | 44 | 76.6 | 4,710 | .147 | .170 |
| September | 68 | 40 | 45.2 | 2,690 | .087 | .097 |
| October | 55 | 40 | 43.4 | 2,669 | .083 | .096 |
| November | 91 | 40 | 56.6 | 3,368 | .109 | .122 |
| December | 100 | 75 | 83.0 | 5,103 | .160 | .184 |
| The year | 2,060 | 40 | 421 | 304,700 | .810 | 10.98 |

## MISCELLANEOUS MEASUREMENTS IN KAWEAH RIVER DRAINAGE BASIN.

*Marble Fork in Sequoia National Park, Cal.*—This stream is one of the principal tributaries of the Kaweah River. A measurement was made October 12 by W. B. Clapp at a point 100 yards above its junction with the Middle Fork of Kaweah River.

Width, 8.1 feet; area, 6.0 square feet; mean velocity, 0.83 foot per second; discharge, 5.0 second-feet.

*Middle Fork of Kaweah River in Sequoia National Park, Cal.*—This stream is one of the principal tributaries of Kaweah river. A measurement was made October 12 by W. B. Clapp at a point 100 yards above its junction with Marble Fork.

Width, 24.5 feet; area, 32.2 square feet; mean velocity, 0.51 foot per second; discharge, 16.3 second-feet.

*South Fork of Kaweah River near Three Rivers, Cal.*—A measurement of this stream was made October 11 by W. B. Clapp, 2 miles above junction of Grouse Creek with South Fork, about 8 miles above the town of Three Rivers.

Width, 3.5 feet; area, 1.7 square-feet; mean velocity, 2.53 feet per second; discharge, 4.3 second-feet.

*East Fork of Kaweah River at power house of Mount Whitney Power Company.*—Estimates of discharge of this stream were made by W. B. Clapp at the power house of Mount Whitney Power Company, 3 miles above the town of Three Rivers, Cal. The estimated discharge was calculated from discharge of nozzles at Mount Whitney Power Company's Plant.

September 28: Operating three Doble wheels. Wheel No. 1, 1½-inch nozzle; wheel No. 2, 2-inch nozzle; wheel No. 3, 2¼-inch nozzle; effective head 1,290 feet; coefficient used, 0.98; discharge, 17.4 second-feet.

October 13: Two wheels running. Wheel No. 2, 2-inch nozzle; wheel No. 3, 2¼-inch nozzle; wheel No. 1, not running; effective head, 1,290 feet; coefficient used, 0.98; discharge, 14 second-feet.

*Mount Whitney Power Company's flume, 100 feet below head-gate at boundary line Sequoia National Park.*—The following measurements were made during 1905 by W. B. Clapp.

September 28: Width, 6.6 feet; area, 7.9 square feet; mean velocity, 2.18 feet per second; discharge, 17.2 second-feet.

October 12: Width, 4.75 feet; area, 6.4 square feet; mean velocity, 2.95 feet per second; discharge, 18.9 second-feet.

These measurements give total flow of Middle Fork of Kaweah River, including Marble Fork.

*North Fork Kaweah River near Three Rivers, Cal.*—A measurement of this stream was made October 13 by W. B. Clapp at a point 5 miles above junction of South Fork with Middle Fork of Kaweah River.

Width, 12 feet; area, 3.2 square feet; mean velocity, 1.50 feet per second; discharge, 4.8 second-feet.

## KINGS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Kings River rises on the western slope of the Sierra Nevada and drains the country located between the San Joaquin River on the north and the Kaweah and Kern rivers on the south. The crest of the Sierra Nevada at the head of this basin reaches elevations of over 14,000 feet, and here is the most rugged portion of the range; the sharp and precipitous peaks characteristic of this part of the Sierra Nevada produce the grandest scenery to be found in the United States. The main tributaries of this stream flow through great canyons cut in the granite, with high precipitous walls. The Kings River Canyon on the South Fork and Tehipite Valley on the Middle Fork rival the famed Yosemite Valley for grandeur of scenery. There are numerous tributaries, many of which have their sources in perpetual snow banks on the higher elevation. A large number of small lakes on the higher elevations are fed by small streams from perpetual snow banks or glaciers, and in them many of the tributaries have their source. The formation is of granite, which above an elevation of 10,000 feet is bare, with scanty vegetation, being carved by the action of glaciers; below the 10,000-foot contour is a heavy covering of timber and underbrush. Extensive groves of big trees are scattered throughout this basin. On the lower elevations along the foothills the soil covering is light with a grass growth used for pasturage. Fully 80 per cent of the drainage area is now included in the boundaries of the Sierra Forest Reserve which is patrolled for the prevention of fires and illegal herding. Below the gaging station, which is located at the point where the river leaves the foothills, canals divert the water for use in the valley lands of Fresno, Kings, and Tulare counties, where the climate and soil are especially adapted to the raising of grapes, fruits, etc., and the soil is under a high state of cultivation. During the period of flood discharge some water passes these canals and finds its way across Kings River delta in the natural channel to the old bed of Tulare Lake, which is now but an intermittent lake due largely to the diversion of water for irrigation purposes from the streams which drain into it.

There is a drainage area of 1,742 square miles above the Red Mountain gaging station. The mean annual precipitation for this area varies from about 30 to 60 inches, which over a greater portion of the basin falls in the form of snow. The greater discharge of this stream is in the spring months when the snow is melting.

### KINGS RIVER NEAR SANGER, CAL.

This station was established September 3, 1895, by J. B. Lippincott. It is located 15 miles east of Sanger, Cal., near the mouth of the canyon, and is above all diversions.

The channel is nearly straight for 300 feet above and below the station, and has a width of 180 feet at ordinary stages. The bed of the stream is composed of gravel and small bowlders and changes but little. The right bank is high and not subject to overflow. The left bank is subject to overflow during extreme high water. The current is swift.

Discharge measurements are made by means of a cable and car. The initial point for soundings is an eyebolt embedded in concrete on the right bank of river. An automatic river stage register was installed April 18, 1903. There is also an inclined wooden gage near by from which readings were formerly taken and which is now used in checking the self-recording gage. Mr. O. G. Williams reads the gage once each day and also examines the automatic register to see that it is in proper working order. The mean daily gage height is determined from the register sheets by the use of planimeter. The bench mark is a cross marked on a rock which is 24 feet upstream from the self-recording register; elevation, 18.00 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Kings River near Sanger, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 21 | F. R. S. Buttemer | 217 | 883 | 2.73 | 6.91 | 2,406 |
| May 22 | R. S. Hawley | 317 | 1,827 | 4.95 | 10.10 | 9,046 |
| June 15 | do | 314 | 1,808 | 4.67 | 10.10 | 8,446 |
| July 24 | do | 169 | 584 | 1.69 | 5.42 | 986 |
| August 19 | do | 145 | 390 | .97 | 4.33 | 382 |
| September 16 | C. H. Lee | 126 | 317 | .63 | 3.82 | 199 |
| October 21 | Hawley and Lee | 113 | 128 | 1.53 | 3.79 | 186 |

*Mean daily gage height, in feet, of Kings River near Sanger, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.65 | 5.0 | 5.5 | 6.25 | 8.9 | 9.0 | 7.8 | 4.95 | 4.1 | 4.05 | 3.8 | 4.10 |
| 2 | 4.55 | 5.65 | 5.7 | 6.5 | 8.35 | 9.05 | 7.6 | 4.85 | 4.05 | 4.0 | 3.8 | 4.05 |
| 3 | 4.45 | 5.6 | 5.85 | 6.6 | 8.05 | 9.15 | 7.5 | 4.8 | 4.0 | 4.0 | 3.8 | 4.0 |
| 4 | 4.45 | 5.45 | 5.95 | 6.7 | 7.7 | 8.85 | 7.4 | 4.8 | 4.0 | 3.9 | 3.8 | 4.1 |
| 5 | 4.4 | 5.7 | 5.9 | 6.9 | 7.55 | 8.7 | 7.3 | 4.7 | 4.0 | 3.85 | 3.8 | 4.15 |
| 6 | 4.4 | 5.65 | 5.9 | 7.05 | 7.65 | 9.05 | 7.25 | 4.65 | 4.0 | 3.85 | 3.8 | 4.1 |
| 7 | *a* 4.4 | 5.4 | 5.9 | 7.2 | 7.75 | 9.35 | 7.25 | 4.6 | 4.0 | 3.8 | 3.8 | 4.1 |
| 8 | *a* 4.4 | 5.3 | 5.95 | 7.2 | 7.9 | 9.3 | 7.2 | 4.6 | 3.95 | 3.8 | 3.8 | 4.1 |
| 9 | 4.4 | 5.25 | 5.95 | 7.25 | 7.7 | 9.1 | 7.2 | 4.6 | 3.95 | 3.8 | 3.8 | 4.05 |
| 10 | 4.35 | 5.15 | 5.9 | 7.25 | 7.4 | 9.4 | 7.2 | 4.65 | 3.9 | 3.8 | 3.8 | 4.0 |
| 11 | 4.4 | 5.05 | 5.9 | 7.0 | 7.4 | 9.8 | 7.15 | 4.6 | 3.9 | 3.75 | *a* 3.8 | 4.0 |
| 12 | 4.3 | 5.0 | 5.95 | 6.75 | 7.4 | 10.25 | 7.0 | 4.55 | 3.9 | 3.75 | 3.8 | 4.0 |
| 13 | 4.2 | 4.85 | 7.15 | 6.6 | 7.45 | 10.3 | 6.7 | 4.55 | 3.9 | 3.75 | 3.8 | 4.0 |
| 14 | 4.35 | 4.85 | 7.35 | 6.6 | 7.95 | 10.2 | 6.4 | 4.5 | 3.9 | 3.7 | 3.8 | 4.0 |
| 15 | *a* 4.35 | 4.85 | 6.65 | 6.9 | 8.8 | 10.0 | 6.2 | 4.45 | 3.9 | 3.7 | 3.8 | 4.0 |
| 16 | 4.35 | 5.0 | 6.55 | 7.05 | 9.6 | 9.9 | 6.0 | 4.45 | 3.85 | 3.7 | 3.8 | 4.0 |
| 17 | 4.4 | 5.4 | 6.75 | 7.0 | 10.25 | 9.85 | 5.85 | 4.4 | 3.8 | 3.7 | 3.8 | 4.0 |
| 18 | 4.4 | 5.25 | 6.75 | 7.3 | 10.15 | 9.6 | 5.75 | 4.4 | 3.8 | 3.75 | 3.8 | 4.0 |
| 19 | 4.35 | 5.2 | 7.0 | 7.2 | 10.15 | 9.4 | 5.65 | 4.35 | 3.8 | 3.75 | 3.9 | 4.0 |
| 20 | 4.45 | 5.15 | 7.2 | 6.9 | 10.05 | 9.4 | 5.6 | 4.3 | 3.8 | 3.8 | 3.95 | 4.05 |
| 21 | 4.7 | 5.1 | 6.9 | 6.85 | 10.15 | 9.45 | 5.55 | 4.3 | 3.8 | 3.8 | 4.0 | 4.1 |
| 22 | 4.8 | 5.1 | 6.55 | 6.8 | 10.15 | 9.4 | 5.55 | 4.3 | 3.75 | 3.8 | 3.9 | 4.0 |
| 23 | 4.6 | 5.15 | 6.4 | 6.8 | 9.95 | 8.95 | 5.5 | 4.3 | 3.75 | 3.8 | 3.9 | 3.9 |
| 24 | 4.6 | 5.2 | 6.5 | 7.1 | 9.95 | 8.45 | 5.5 | 4.25 | 3.75 | 3.8 | 3.8 | 3.9 |
| 25 | 4.55 | 5.25 | 6.6 | 7.5 | 10.15 | 8.2 | 5.5 | 4.2 | 3.75 | 3.7 | 3.8 | *a* 3.9 |
| 26 | 4.5 | 5.3 | 6.8 | 7.5 | 10.15 | 8.25 | 5.5 | 4.2 | 3.7 | 3.7 | 3.85 | 3.9 |
| 27 | 4.45 | 5.3 | 6.7 | 7.75 | 9.4 | 8.05 | 5.45 | 4.2 | 3.7 | 3.7 | 3.9 | 4.0 |
| 28 | 4.45 | 5.35 | 6.4 | 8.2 | 8.85 | 7.95 | 5.4 | 4.15 | 3.7 | 3.7 | 4.1 | 4.0 |
| 29 | 4.45 | ....... | 6.55 | 8.75 | 8.5 | 8.0 | 5.25 | 4.1 | 3.75 | 3.75 | 4.0 | 4.0 |
| 30 | 4.45 | ....... | 6.4 | 9.05 | 8.65 | 8.0 | 5.15 | 4.1 | 3.95 | 3.75 | *a* 4.0 | 4.0 |
| 31 | 4.5 | ....... | 6.25 | ....... | 8.9 | ....... | 5.05 | 4.1 | ....... | 3.75 | ....... | 3.9 |

*a* Gage height estimated.

*Station rating table for Kings River near Sanger, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.70 | 150 | 5.00 | 740 | 6.30 | 1,730 | 8.00 | 3,850 |
| 3.80 | 175 | 5.10 | 805 | 6.40 | 1,820 | 8.20 | 4,190 |
| 3.90 | 205 | 5.20 | 870 | 6.50 | 1,920 | 8.40 | 4,570 |
| 4.00 | 240 | 5.30 | 940 | 6.60 | 2,020 | 8.60 | 4,980 |
| 4.10 | 280 | 5.40 | 1,010 | 6.70 | 2,120 | 8.80 | 5,425 |
| 4.20 | 325 | 5.50 | 1,085 | 6.80 | 2,230 | 9.00 | 5,890 |
| 4.30 | 370 | 5.60 | 1,160 | 6.90 | 2,340 | 9.20 | 6,380 |
| 4.40 | 420 | 5.70 | 1,235 | 7.00 | 2,460 | 9.40 | 6,915 |
| 4.50 | 470 | 5.80 | 1,310 | 7.20 | 2,705 | 9.60 | 7,495 |
| 4.60 | 520 | 5.90 | 1,390 | 7.40 | 2,965 | 9.80 | 8,115 |
| 4.70 | 570 | 6.00 | 1,470 | 7.60 | 3,240 | 10.00 | 8,770 |
| 4.80 | 625 | 6.10 | 1,550 | 7.80 | 3,535 | 10.20 | 9,450 |
| 4.90 | 680 | 6.20 | 1,640 | | | | |

NOTE.—The above table is based on discharge measurements made during 1895–1905. It is well defined throughout.

*Estimated monthly discharge of Kings River near Sanger, Cal., for 1905.*

[Drainage area, 1,742 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 625 | 325 | 447 | 27,480 | 0.257 | 0.296 |
| February | 1,235 | 652 | 899 | 49,930 | .516 | .537 |
| March | 2,900 | 1,085 | 1,844 | 113,400 | 1.06 | 1.22 |
| April | 6,010 | 1,685 | 2,731 | 162,500 | 1.57 | 1.75 |
| May | 9,622 | 2,965 | 5,887 | 361,600 | 3.38 | 3.90 |
| June | 9,795 | 3,770 | 6,448 | 383,700 | 3.70 | 4.13 |
| July | 3,535 | 772 | 1,859 | 114,300 | 1.07 | 1.23 |
| August | 710 | 280 | 448 | 27,550 | .257 | .296 |
| September | 280 | 150 | 198 | 11,780 | .114 | .127 |
| October | 260 | 150 | 174 | 10,700 | .100 | .115 |
| November | 280 | 175 | 191 | 11,360 | .110 | .123 |
| December | 302 | 205 | 246 | 15,130 | .141 | .163 |
| The year | 9,795 | 150 | 1,781 | 1,289,000 | 1.02 | 13.89 |

## MISCELLANEOUS MEASUREMENTS IN KINGS RIVER DRAINAGE BASIN.

*North Fork of Kings River.*—This stream enters Kings River from the north about 20 miles above point where the main Kings River leaves the foothills and enters the San Joaquin Valley. A measurement was made 500 feet above its junction with main river and about 50 feet above lower trail crossing on August 22, 1905, by R. S. Hawley.

Width, 16 feet; area, 21 square feet; mean velocity, 1.86 feet per second; discharge, 39 second-feet.

*Converse Creek.*—This stream enters the Kings River 7 miles below the junction of Middle and South forks. A measurement was made 200 feet above its mouth on August 23, 1905, by R. S. Hawley.

Width, 4 feet; area, 1.6 square feet; mean velocity, 0.77 foot per second; discharge, 1.2 second-feet.

*Ten Mile Creek.*—This creek enters Kings River one-half mile below junction of Middle and South forks. A measurement was made on August 23, 1905, 100 feet above its mouth by R. S. Hawley.

Width, 2 feet; area, 1.6 square feet; mean velocity, 0.69 foot per second; discharge, 1.1 second-feet.

*Boulder Creek.*—This stream enters the South Fork of Kings River 5 miles above the junction of the Middle and South forks. A measurement was made on August 25, 1905, 2 miles above its mouth and 100 feet above lower trail crossing by R. S. Hawley.

Width, 6 feet; area, 2.8 square feet; mean velocity, 1.14 feet per second; discharge, 3.2 second-feet.

*Lightning Creek.*—This stream enters the South Fork of Kings River from the south about 10 miles above the junction of the Middle and South forks. An estimate was made of the discharge about 1 mile above its mouth at the trail crossing on August 25, 1905, by R. S. Hawley.

Discharge, 0.60 second-foot.

*Lewis Creek.*—This stream enters the South Fork of Kings River from the north in Kings River Canyon 2 miles below old Cedar Grove Hotel. A measurement was made August 26, 1905, 500 feet above its mouth by R. S. Hawley.

Width, 3 feet; area, 2.7 square feet; mean velocity, 1.00 foot per second; discharge, 2.7 second-feet.

*South Fork of Kings River.*—This stream is the principal tributary to Kings River. A measurement was made in the lower Kings River Canyon one-fourth mile above the mouth of Lewis Creek on August 26, 1905, by R. S. Hawley.

Width, 52 feet; area, 51 square feet; mean velocity, 2.73 feet per second; discharge, 139 second-feet.

*South Fork of Kings River.*—A measurement was made 700 feet above the mouth of Bubbs Creek on August 26, 1905, by R. S. Hawley.

Width, 35 feet; area, 36 square feet; mean velocity, 1.36 feet per second; discharge, 49 second-feet.

*South Fork of Kings River.*—A measurement was made August 26, 1905, one-fourth mile below the mouth of Bubbs Creek by R. S. Hawley.

Width, 65 feet; area, 68 square feet; mean velocity, 1.46 feet per second; discharge, 99 second-feet.

*Bubbs Creek.*—This is the principal tributary of South Fork of Kings River and joins it at the head of Kings River Canyon. From the measurements made on South Fork of Kings River above and below the junction of Bubbs Creek on August 26, 1905, by R. S. Hawley, the discharge of Bubbs Creek at the mouth was estimated to be 50 second-feet. On account of roughness of stream bed and high velocities in the creek it was impossible to make discharge measurement. (See measurement of South Fork of Kings River above and below mouth of Bubbs Creek.)

*Copper Creek.*—This stream enters the South Fork of Kings River from the north between North Dome and Buck Peak. A measurement was made on August 26, 1905, one-fourth mile above its mouth by R. S. Hawley.

Width, 4 feet; area, 1.0 square foot; mean velocity, 0.82 foot per second; discharge, 0.82 second-foot.

*Roaring River.*—This stream enters South Fork of Kings River from the south, 5 miles below the junction of South Fork and Bubbs Creek. A measurement was made August 26, 1905, 500 feet above its mouth by R. S. Hawley.

Width, 14 feet; area, 11 square feet; mean velocity, 0.87 foot per second; discharge, 9.6 second-feet.

*Sheep Creek.*—This stream enters the South Fork of Kings River from the south one-fourth mile below Cedar Grove Hotel. An estimate was made of the discharge at the mouth August 26, 1905, by R. S. Hawley.

Discharge, 1.8 second-feet.

*Hotel Creek.*—This stream enters South Fork of Kings River from the north at Cedar Grove Hotel. An estimate was made of the discharge at its mouth on August 26, 1905, by R. S. Hawley.

Discharge, 0.20 second-foot.

*Granite Creek.*—This stream enters South Fork of Kings River from the north between North Mountain and North Dome. An estimate was made of the discharge at the mouth August 26, 1905, by R. S. Hawley.

Discharge, 0.50 second-foot.

*Horseshoe Creek.*—This stream enters Middle Fork of Kings River from the south at Simpson Meadow. An estimate was made of the discharge at its mouth on August 28, 1905, by R. S. Hawley.

Discharge, 2.4 second-feet.

*Middle Fork of Kings River.*—This is one of the principal tributaries of Kings River and drains the high Sierra Nevadas in the northeastern portion of its watershed. A measurement was made on August 28, 1905, 50 feet above the mouth of Horseshoe Creek, at the lower end of Simpson Meadow, by R. S. Hawley.

Width, 41 feet; area, 65 square feet; mean velocity, 1.83 feet per second; discharge, 119 second-feet.

*Goddard Creek.*—This stream is the principal tributary of Middle Fork of Kings River, entering it from the north. A measurement was made August 28, 1905, one-fourth mile above its mouth at Simpson Meadow by R. S. Hawley.

Width, 26 feet; area, 29 square feet; mean velocity, 1.93 feet per second; discharge, 56 second-feet.

*Dougherty Creek.*—This stream enters Middle Fork of Kings River from the south about 1 mile below Simpson Meadow. A measurement was made August 29, 1905, 300 feet above its mouth by R. S. Hawley.

Width, 4 feet; area 4.4 square feet; mean velocity, 0.86 foot per second; discharge, 3.8 second-feet.

*Slide Creek.*—This is a small stream entering Middle Fork of Kings River from the south 3 miles below Simpson Meadow. An estimate of its discharge was made 300 feet above its mouth August 29, 1905, by R. S. Hawley.

Discharge, 0.50 second-foot.

*Crown Creek.*—This stream enters Middle Fork of Kings River in Tehipite Valley one-half mile southwest of Tehipite Dome. An estimate of its discharge was made on August 29, 1905, 500 feet above its mouth, above the trail crossing, by R. S. Hawley.

Discharge, 8.0 second-feet.

*Blue Canyon Creek.*—This stream enters Middle Fork of Kings River 2 miles above Tehipite Dome. An estimate was made of the discharge August 29, 1905, 200 feet above its mouth by R. S. Hawley.

Discharge, 1.4 second-feet.

*Rancheria Creek.*—This stream enters North Fork of Kings River about 4 miles below Cliff Camp. A measurement was made on August 31, 1905, about 4 miles above its mouth and just below its junction with North Fork of Rancheria Creek by R. S. Hawley.

Width, 8 feet; area, 7.2 square feet; mean velocity, 0.78 foot per second; discharge, 5.6 second-feet.

*North Fork of Rancheria Creek.*—This stream joins Rancheria Creek about 4 miles above its mouth. A measurement was made August 31, 1905, 100 feet above its junction with Rancheria Creek, by R. S. Hawley.

Width, 2 feet; area, 1.2 square feet; mean velocity, 2.00 feet per second; discharge, 2.4 second-feet.

*North Fork of Kings River.*—A measurement was made on this stream on August 31, 1905, about one-half mile above Cliff Camp and about 15 miles above its mouth, by R. S. Hawley.

Width, 8.0 feet; area, 12.8 square feet; mean velocity, 0.73 foot per second; discharge, 9.4 second-feet.

*Bear Creek.*—This stream is tributary to North Fork of Kings River through Dinkey Creek. An estimate was made of the discharge of this stream on August 31, 1905, about 2 miles above its junction with Dinkey Creek at trail crossing, by R. S. Hawley.

Discharge, 0.70 second-foot.

*Laurel Creek.*—This stream is tributary to North Fork of Kings River through Bear Creek and Dinkey Creek. An estimate was made of the discharge on August 31, 1905, about one-fourth mile above junction with Bear Creek, by R. S. Hawley.

Discharge, 0.40 second-foot.

*Dinkey Creek.*—This stream is a tributary of North Fork of Kings River from the west. A measurement was made about 1½ miles above the mouth of Bear Creek at Dinkey Meadows on September 1, 1905, by R. S. Hawley.

Width, 6 feet; area, 4 square feet; mean velocity, 0.70 foot per second; discharge, 2.8 second-feet.

## MERCED RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Merced River drains that portion of the western slope of the Sierra Nevada located between the Tuolumne River on the north and the San Joaquin River on the south. Its drainage area is much less than that of the Tuolumne River. It has numerous tributaries, several of which are of considerable size.

The topography of the country in this basin is similar to that of the Tuolumne River, being rough and broken in the upper reaches. In this basin is situated the famous Yosemite

Valley with its precipitous walls and domes and great waterfalls, which occur on the main stream and its tributaries, which discharge into the valley over precipitous cliffs rising 2,000 to 3,000 feet above the floor of the valley. The formation is of granite which on the upper reaches of the basin above Yosemite Valley is bare, rising in precipitous peaks and domes, and is smoothly marked by glacial action. The middle reaches of the basin are well timbered. The Mariposa grove of big trees is situated in the basin of the South Fork. The timber growth extends well down on the lower elevations to the foothills where the covering is of brush and grass, used extensively for pasturage. Numerous lakes are scattered over the upper portion of the basin. The mean annual precipitation varies from 25 inches in the foothills to 60 inches on the higher elevations, where it falls in the form of snow, which melts in the spring months, except on the extreme higher mountain peaks, where it often remains during the entire year. After leaving the foothills at Merced Falls, where the gaging station is located, canals divert the water for irrigation on lands along the river bottom and in San Joaquin Valley. The surplus water during flood discharge enters San Joaquin River.

### MERCED RIVER IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904, by A. E. Chandler and N. W. Currie. It is located at the wagon bridge, near the Sentinel Hotel.

The channel is straight for a distance of 150 feet above and 50 feet below station. The current is sluggish. The right bank is low and subject to overflow. The left bank is high and above high water. The bed of the stream is composed of coarse gravel and sand, with small bowlders, and is not subject to much change.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is stream face of abutment on right bank.

The gage is a vertical timber, securely fastened to a masonry abutment on west bank. The bench mark is the heads of two large nails driven into the stream face of the bridge-seat timber on the left abutment; elevation, 14.64 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Merced River in Yosemite Valley, California, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 6 | W. B. Clapp | 93 | 593 | 2.40 | 6.15 | 1,421 |
| June 8 | do | 93 | 626 | 2.58 | 6.45 | 1,617 |
| June 11 | N. W. Currie | 93 | 730 | 3.14 | 6.95 | 2,289 |
| June 12 | do | 93 | 782 | 3.52 | 7.52 | 2,751 |
| June 20 | do | 93 | 730 | 3.07 | 6.92 | 2,240 |
| June 25 | do | 93 | 594 | 2.28 | 6.00 | 1,354 |
| June 28 | do | 90 | 568 | 2.15 | 5.70 | 1,221 |
| July 4 | do | 90 | 518 | 1.90 | 5.40 | 984 |
| July 13 | do | 90 | 448 | 1.44 | 4.80 | 647 |
| July 17 | do | 90 | 396 | .92 | 4.20 | 365 |
| July 31 | do | 92 | 362 | .52 | 3.78 | 190 |
| August 25 | do | 92 | 308 | .30 | 3.40 | 91 |
| October 24 | do | 20 | 10.5 | 1.46 | 3.10 | [a]15.3 |

[a] Wading 400 feet below bridge.

*Daily gage height, in feet, of Merced River in Yosemite Valley, California, for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 6.2 | 5.7 | 3.7 | 3.3 | 3.3 | 17 | ...... | 7.1 | 4.2 | 3.5 | 3.1 | [a]3.15 |
| 2 | ...... | 6.2 | 5.5 | 3.7 | 3.3 | [a]3.3 | 18 | ...... | 6.9 | 4.15 | 3.5 | 3.1 | [a]3.15 |
| 3 | ...... | 6.1 | 5.3 | 3.7 | 3.3 | 3.25 | 19 | ...... | 6.8 | 4.2 | 3.45 | 3.15 | [a]3.15 |
| 4 | ...... | 5.95 | 5.4 | 3.7 | 3.25 | [a]3.25 | 20 | ...... | 6.9 | 4.2 | 3.45 | 3.2 | [a]3.1 |
| 5 | ...... | 5.8 | 5.35 | 3.65 | 3.2 | [a]3.25 | 21 | ...... | 7.1 | 4.2 | 3.45 | 3.2 | 3.1 |
| 6 | ...... | 6.2 | 5.35 | 3.6 | 3.2 | [a]3.25 | 22 | ...... | 7.0 | 4.2 | 3.45 | 3.2 | [a]3.1 |
| 7 | ...... | 6.5 | 5.3 | 3.6 | 3.2 | 3.25 | 23 | 6.8 | 6.5 | 4.2 | 3.45 | 3.3 | [a]3.1 |
| 8 | ...... | 6.4 | 5.25 | 3.6 | 3.2 | [a]3.25 | 24 | 6.8 | 6.5 | 4.2 | 3.4 | 3.3 | 3.1 |
| 9 | ...... | 6.2 | 5.5 | 3.7 | 3.2 | [a]3.2 | 25 | 7.1 | 6.0 | 4.1 | 3.4 | 3.3 | ...... |
| 10 | ...... | 6.55 | 5.5 | 3.7 | 3.2 | 3.2 | 26 | 7.1 | 6.0 | 4.1 | 3.35 | 3.3 | ...... |
| 11 | ...... | 7.0 | 5.3 | 3.7 | 3.2 | [a]3.2 | 27 | 6.3 | 5.8 | 4.1 | 3.3 | 3.3 | ...... |
| 12 | ...... | 7.5 | 5.1 | 3.6 | 3.15 | 3.2 | 28 | [a]6.0 | 5.7 | 4.0 | 3.3 | 3.4 | ...... |
| 13 | ...... | 7.45 | 4.8 | 3.6 | 3.1 | [a]3.2 | 29 | 5.7 | 5.95 | 3.9 | 3.3 | 3.4 | ...... |
| 14 | ...... | 7.35 | 4.5 | 3.5 | 3.1 | 3.15 | 30 | 6.1 | 5.8 | 3.8 | 3.3 | 3.35 | ...... |
| 15 | ...... | 7.3 | 4.35 | 3.5 | 3.1 | 3.15 | 31 | 6.1 | ...... | 3.8 | 3.3 | ...... | ...... |
| 16 | ...... | 7.4 | 4.3 | 3.5 | 3.1 | [a]3.15 | | | | | | | |

[a] Gage height estimated.

*Station rating table for Merced River in Yosemite Valley, California, from July 11, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 15 | 4.10 | 326 | 5.10 | 815 | 6.20 | 1,505 |
| 3.20 | 38 | 4.20 | 368 | 5.20 | 870 | 6.40 | 1,645 |
| 3.30 | 63 | 4.30 | 412 | 5.30 | 925 | 6.60 | 1,795 |
| 3.40 | 90 | 4.40 | 457 | 5.40 | 985 | 6.80 | 1,950 |
| 3.50 | 118 | 4.50 | 504 | 5.50 | 1,045 | 7.00 | 2,110 |
| 3.60 | 147 | 4.60 | 552 | 5.60 | 1,105 | 7.20 | 2,275 |
| 3.70 | 178 | 4.70 | 602 | 5.70 | 1,170 | 7.40 | 2,445 |
| 3.80 | 212 | 4.80 | 653 | 5.80 | 1,235 | | |
| 3.90 | 248 | 4.90 | 706 | 5.90 | 1,300 | | |
| 4.00 | 286 | 5.00 | 760 | 6.00 | 1,365 | | |

NOTE.—The above table is based on 12 discharge measurements made during 1904-5. It is well defined between gage heights 3.1 feet and 6.5 feet.

*Estimated monthly discharge of Merced River in Yosemite Valley, California, for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| July 11-31 | 602 | 286 | 463 | 19,280 |
| August | 552 | 112 | 248 | 15,250 |
| September 1-24 | 412 | 63 | 131 | 6,236 |
| 1905. | | | | |
| May 23-31 | 2,190 | 1,170 | 1,696 | 30,280 |
| June | 2,530 | 1,170 | 1,771 | 105,400 |
| July | 1,170 | 212 | 610 | 37,510 |
| August | 178 | 63 | 123 | 7,563 |
| September | 90 | 15 | 44.4 | 2,642 |
| October 1-24 | 63 | 15 | 35.3 | 1,680 |
| The period | | | | 185,100 |

## MERCED RIVER ABOVE MERCED FALLS, CAL.

The measurement of this stream was undertaken in response to numerous requests from mining and irrigation interests. The midsummer flow of the stream is less than the combined capacity of the irrigation and power canals taking water in the vicinity of Snelling. The station was established April 6, 1901, by H. H. Henderson. It is located 1 mile above Merced Falls.

Both banks are high and rocky and are not subject to overflow. The bed of the stream is composed of gravel and is subject to some change.

Discharge measurements are made from a cable and car.

The gage is a timber bolted to iron stakes driven in the bed of the stream on the left bank. During 1905 the gage was read by Charles Siegfeldt. The bench mark is a three-fourths inch round iron bolt set 10 inches in the slate rock on the right bank of the river; elevation, 69.20 feet above the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Merced River above Merced Falls, California, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 16 | F. R. S. Buttemer | 179 | 447 | 2.84 | 10.19 | 1,269 |
| April 7 | O. W. Peterson | 184 | 597 | 3.79 | 10.75 | 2,263 |
| May 24 | R. S. Hawley | 265 | 862 | 4.94 | 11.91 | 4,261 |
| June 17 | do | 272 | 797 | 4.56 | 11.65 | 3,632 |
| July 21 | do | 141 | 282 | 1.74 | 9.04 | 490 |
| September 14 | C. H. Lee | 106 | 128 | .43 | 7.82 | 56 |
| October 19 | Hawley and Lee | 104 | 128 | .37 | 7.80 | 48 |
| October 19 | do | 44 | 38 | 1.34 | 7.80 | 51 |
| December 7 | Hawley and Eaton | 65 | 57 | 1.58 | 8.00 | 90 |

*Daily gage height, in feet, of Merced River above Merced Falls, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.2 | 9.2 | 9.5 | 10.15 | 11.55 | 11.45 | 10.4 | 8.6 | 8.0 | 7.85 | 7.85 | 8.1 |
| 2 | 8.95 | 13.45 | 9.6 | 10.2 | 11.2 | 11.35 | 10.25 | 8.5 | 7.95 | 7.8 | 7.8 | 8.1 |
| 3 | 8.85 | 10.75 | 9.7 | 10.3 | 10.95 | 11.35 | 10.15 | 8.5 | 7.95 | 7.9 | 7.85 | 8.0 |
| 4 | 8.8 | 10.45 | 9.8 | 10.4 | 10.8 | 11.2 | 10.05 | 8.45 | 8.0 | 7.8 | 7.8 | 7.95 |
| 5 | 8.7 | 10.8 | 9.8 | 10.5 | 10.7 | 11.05 | 10.05 | 8.4 | 8.05 | 7.9 | 7.8 | 8.0 |
| 6 | 8.7 | 10.35 | 9.75 | 10.6 | 10.6 | 11.2 | 9.95 | 8.4 | 8.0 | 7.9 | 7.8 | 8.0 |
| 7 | 8.7 | 9.85 | 9.8 | 10.7 | 10.7 | 11.45 | 9.95 | 8.35 | 7.9 | 7.9 | 7.8 | 8.0 |
| 8 | 8.7 | 9.65 | 9.85 | 10.7 | 11.05 | 11.45 | 9.9 | 8.35 | 7.9 | 7.9 | 7.8 | 8.0 |
| 9 | 8.7 | 9.5 | 9.85 | 10.7 | 10.85 | 11.35 | 9.95 | 8.4 | 7.9 | 7.9 | 7.8 | 8.0 |
| 10 | 8.7 | 9.4 | 9.85 | 10.75 | 10.65 | 11.35 | 10.0 | 8.3 | 7.9 | 7.9 | 7.85 | 8.0 |
| 11 | 8.7 | 9.3 | 9.85 | 10.6 | 10.6 | 11.6 | 9.9 | 8.35 | 7.9 | 7.9 | 7.85 | 8.0 |
| 12 | 8.65 | 9.25 | 9.8 | 10.4 | 10.5 | 11.95 | 9.8 | 8.4 | 7.9 | 7.8 | 7.9 | 7.9 |
| 13 | 8.6 | 9.1 | 10.95 | 10.3 | 10.6 | 11.85 | 9.7 | 8.4 | 7.9 | 7.8 | 7.8 | 7.9 |
| 14 | 8.6 | 9.1 | 10.6 | 10.25 | 10.85 | 11.75 | 9.55 | 8.35 | 7.85 | 7.85 | 7.8 | 7.9 |
| 15 | 8.6 | 9.1 | 10.25 | 10.4 | 11.35 | 11.7 | 9.35 | 8.3 | 7.8 | 7.85 | 7.8 | 7.95 |
| 16 | 8.7 | 9.1 | 10.15 | 10.6 | 12.05 | 11.7 | 9.25 | 8.25 | 7.85 | 7.8 | 7.85 | 7.95 |
| 17 | 8.7 | 9.3 | 11.3 | 10.5 | 12.7 | 11.6 | 9.1 | 8.2 | 7.85 | 7.8 | 7.85 | 8.0 |
| 18 | 8.6 | 9.3 | 10.7 | 10.55 | 12.5 | 11.45 | 9.1 | 8.2 | 7.85 | 7.8 | 7.85 | 8.1 |
| 19 | 8.7 | 9.3 | 13.55 | 10.8 | 12.25 | 11.4 | 9.05 | 8.15 | 7.85 | 7.8 | 7.85 | 8.1 |
| 20 | 8.7 | 9.35 | 11.75 | 10.55 | 12.35 | 11.3 | 9.0 | 8.1 | 7.8 | 7.8 | 7.9 | 8.05 |
| 21 | 8.9 | 9.35 | 10.9 | 10.4 | 12.25 | 11.3 | 9.0 | 8.1 | 7.8 | 7.8 | 7.9 | 8.1 |
| 22 | 9.05 | 9.3 | 10.55 | 10.35 | 11.95 | 11.3 | 9.0 | 8.1 | 7.8 | 7.85 | 7.9 | 8.05 |
| 23 | 8.9 | 9.25 | 10.3 | 10.35 | 11.8 | 11.05 | 9.0 | 8.1 | 7.75 | 7.9 | 7.9 | 8.05 |
| 24 | 8.85 | 9.25 | 10.3 | 10.55 | 11.9 | 10.85 | 9.0 | 8.1 | 7.8 | 7.85 | 7.9 | 8.0 |
| 25 | 8.85 | 9.3 | 10.25 | 10.8 | 12.05 | 10.65 | 9.0 | 8.1 | 7.7 | 7.85 | 7.9 | 8.0 |
| 26 | 8.8 | 9.4 | 10.3 | 10.85 | 12.05 | 10.6 | 8.9 | 8.1 | 7.7 | 7.85 | 7.9 | 8.0 |
| 27 | 8.75 | 9.4 | 10.45 | 11.0 | 11.65 | 10.55 | 8.9 | 8.1 | 7.8 | 7.85 | 8.0 | 8.0 |
| 28 | 8.7 | 9.4 | 10.2 | 11.4 | 11.4 | 10.45 | 8.85 | 8.1 | 7.8 | 7.85 | 7.95 | 8.05 |
| 29 | 8.7 | ....... | 10.4 | 11.75 | 11.15 | 10.5 | 8.8 | 8.0 | 7.8 | 7.85 | 8.25 | 8.2 |
| 30 | 8.7 | ....... | 10.35 | 11.8 | 11.2 | 10.5 | 8.75 | 8.0 | 7.8 | 7.8 | 8.15 | 8.2 |
| 31 | 8.8 | ....... | 10.2 | ....... | 11.35 | ....... | 8.65 | 8.0 | ....... | 7.8 | ....... | 8.2 |

*Station rating table for Merced River above Merced Falls, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 7.70 | 35 | 9.00 | 465 | 10.30 | 1,570 | 11.60 | 3,570 |
| 7.80 | 50 | 9.10 | 520 | 10.40 | 1,690 | 11.70 | 3,755 |
| 7.90 | 70 | 9.20 | 580 | 10.50 | 1,820 | 11.80 | 3,945 |
| 8.00 | 90 | 9.30 | 645 | 10.60 | 1,955 | 11.90 | 4,140 |
| 8.10 | 115 | 9.40 | 715 | 10.70 | 2,095 | 12.00 | 4,340 |
| 8.20 | 140 | 9.50 | 790 | 10.80 | 2,240 | 12.20 | 4,755 |
| 8.30 | 170 | 9.60 | 870 | 10.90 | 2,390 | 12.40 | 5,200 |
| 8.40 | 200 | 9.70 | 955 | 11.00 | 2,545 | 12.60 | 5,665 |
| 8.50 | 235 | 9.80 | 1,045 | 11.10 | 2,705 | 12.80 | 6,140 |
| 8.60 | 275 | 9.90 | 1,140 | 11.20 | 2,870 | 13.00 | 6,630 |
| 8.70 | 315 | 10.00 | 1,240 | 11.30 | 3,040 | | |
| 8.80 | 360 | 10.10 | 1,345 | 11.40 | 3,215 | | |
| 8.90 | 410 | 10.20 | 1,455 | 11.50 | 3,390 | | |

NOTE.—The above table is based on 9 discharge measurements made during 1905. It is well defined between gage heights 7.8 feet and 12 feet.

*Estimated monthly discharge of Merced River above Merced Falls, Cal., for 1905.*

[Drainage area, 1,090 square miles.]

| Month. | Discharge in second-feet. |  |  | Total in acre-feet. | Run-off. |  |
|---|---|---|---|---|---|---|
|  | Maximum. | Minimum. | Mean. |  | Second-feet per square mile. | Depth in inches. |
| January | 580 | 275 | 345 | 21,210 | 0.317 | 0.366 |
| February | 7,760 | 520 | 1,105 | 61,370 | 1.01 | 1.05 |
| March | 8,020 | 790 | 1,774 | 109,100 | 1.63 | 1.88 |
| April | 3,945 | 1,400 | 2,050 | 122,000 | 1.88 | 2.10 |
| May | 5,900 | 1,820 | 3,316 | 203,900 | 3.04 | 3.50 |
| June | 4,240 | 1,755 | 2,980 | 177,300 | 2.73 | 3.05 |
| July | 1,690 | 295 | 804 | 49,440 | .738 | .851 |
| August | 275 | 90 | 158 | 9,715 | .145 | .167 |
| September | 102 | 35 | 62.8 | 3,737 | .068 | .065 |
| October | 70 | 50 | 59.0 | 3,628 | .054 | .062 |
| November | 155 | 50 | 66.4 | 3,951 | .061 | .068 |
| December | 140 | 70 | 97.5 | 5,995 | .089 | .103 |
| The year | 8,020 | 35 | 1,068 | 771,300 | .979 | 13.26 |

## YOSEMITE CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 9, 1904, by A. E. Chandler and N. W. Currie. It is located at the wagon bridge, about one-half mile from Yosemite, Cal.

The channel is straight for 50 feet above and 100 feet below station. Both banks are above high water. The bed of the stream is composed of small granite fragments and is permanent.

Discharge measurements are made from the lower side of the bridge. The initial point for soundings is the stream face of the abutment on the right bank.

The gage is a vertical timber securely fastened to an alder tree on the right bank 50 feet above bridge. The bench mark is the heads of two nails driven in the alder tree, to which the gage is fastened. Elevation, 9.40 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Yosemite Creek in Yosemite Valley, California, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
|  |  | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 7 | W. B. Clapp | 39 | 106 | 2.19 | 6.05 | 232 |
| June 13 | N. W. Currie | 37 | 122 | 2.39 | 6.55 | 290 |
| June 19 | do | 40 | 100 | 2.8 | 5.78 | 208 |
| June 24 | do | 35 | 82 | 1.72 | 5.40 | 141 |
| June 27 | do | 35 | 76 | 1.54 | 5.15 | 117 |
| July 4 | do | 33 | 57 | 1.16 | 4.75 | 66 |
| July 14 | do | 31 | 42 | .71 | 4.30 | 30 |
| July 23 | do | 29 | 35 | .42 | 4.10 | 14.7 |
| August 1 | do | 28 | 29 | .08 | 3.90 | 2.3 |

*Daily gage height, in feet, of Yosemite Creek in Yosemite Valley, California, for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 6.3 | 5.0 | 3.9 | 3.7 | 3.7 | 17 | ...... | 6.0 | 4.2 | 3.79 | 3.7 | [a]3.65 |
| 2 | ...... | 6.4 | 4.9 | 3.7 | 3.7 | [a]3.7 | 18 | ...... | 5.9 | 4.2 | 3.79 | [a]3.7 | [a]3.65 |
| 3 | ...... | 6.3 | 4.8 | 3.85 | 3.7 | 3.65 | 19 | ...... | 5.78 | 4.2 | 3.75 | [a]3.7 | [a]3.65 |
| 4 | ...... | 5.95 | 4.75 | 3.85 | 3.7 | [a]3.65 | 20 | ...... | 5.75 | 4.2 | 3.75 | [a]3.7 | [a]3.65 |
| 5 | ...... | 5.8 | 4.75 | 3.85 | 3.7 | [a]3.65 | 21 | ...... | 5.9 | 4.18 | 3.75 | [a]3.7 | 3.65 |
| 6 | ...... | 5.9 | 4.75 | 3.8 | 3.7 | [a]3.65 | 22 | ...... | 5.7 | 4.15 | 3.75 | 3.65 | [a]3.65 |
| 7 | ...... | 6.2 | 4.7 | 3.8 | 3.7 | 3.65 | 23 | 6.7 | 5.4 | 4.1 | 3.75 | [a]3.65 | [a]3.65 |
| 8 | ...... | 6.1 | 4.7 | 3.7 | 3.7 | [a]3.65 | 24 | 6.7 | 5.4 | 4.1 | 3.75 | 3.65 | 3.65 |
| 9 | ...... | 6.0 | 4.75 | 3.8 | 3.7 | [a]3.65 | 25 | 6.8 | 5.25 | 4.0 | 3.75 | [a]3.65 | ...... |
| 10 | ...... | 6.5 | 4.7 | 3.8 | 3.7 | [a]3.65 | 26 | 6.8 | 5.3 | 4.0 | 3.75 | [a]3.65 | ...... |
| 11 | ...... | 6.3 | 4.6 | 3.8 | 3.7 | [a]3.65 | 27 | 6.3 | 5.15 | 4.0 | 3.72 | [a]3.65 | ...... |
| 12 | ...... | 6.4 | 4.5 | 3.8 | [a]3.7 | [a]3.65 | 28 | 6.2 | 5.0 | 3.95 | 3.7 | 3.7 | ...... |
| 13 | ...... | 6.55 | 4.4 | 3.78 | 3.7 | [a]3.65 | 29 | 6.0 | 5.2 | 3.95 | 3.7 | [a]3.7 | ...... |
| 14 | ...... | 6.35 | 4.3 | 3.8 | 3.7 | 3.65 | 30 | 6.3 | 5.0 | 3.9 | 3.7 | 3.7 | ...... |
| 15 | ...... | 6.35 | 4.25 | 3.8 | 3.7 | [a]3.65 | 31 | 6.3 | ...... | 3.9 | 3.7 | ...... | ...... |
| 16 | ...... | 6.35 | 4.25 | 3.79 | 3.7 | [a]3.65 | | | | | | | |

[a] Estimated.

*Station rating table for Yosemite Creek in Yosemite Valley, California, from July 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.70 | 2 | 4.60 | 50 | 5.50 | 150 | 6.40 | 280 |
| 3.80 | 3 | 4.70 | 59 | 5.60 | 163 | 6.50 | 296 |
| 3.90 | 5 | 4.80 | 69 | 5.70 | 177 | 6.60 | 312 |
| 4.00 | 8 | 4.90 | 79 | 5.80 | 191 | 6.70 | 328 |
| 4.10 | 14 | 5.00 | 90 | 5.90 | 205 | 6.80 | 344 |
| 4.20 | 20 | 5.10 | 101 | 6.00 | 220 | 6.90 | 360 |
| 4.30 | 27 | 5.20 | 113 | 6.10 | 235 | 7.00 | 377 |
| 4.40 | 34 | 5.30 | 125 | 6.20 | 250 | | |
| 4.50 | 42 | 5.40 | 137 | 6.30 | 265 | | |

NOTE.—The above table is based on 11 discharge measurements made during 1904–5. It is well defined.

*Estimated monthly discharge of Yosemite Creek in Yosemite Valley, California, for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| July 11 to 31 | 59 | 8 | 32.2 | 1,341 |
| August | 59 | 3 | 9.9 | 609 |
| September 1 to 24 | 50 | 2.5 | 4.7 | 224 |
| 1905. | | | | |
| May 23 to 31 | 344 | 220 | 290 | 5,177 |
| June | 304 | 96 | 206 | 12,260 |
| July | 90 | 5 | 34.3 | 2,109 |
| August | 5 | 2 | 2.8 | 172 |
| September | 2 | 1.5 | 1.9 | 113 |
| October 1 to 24 | 2 | 1.5 | 1.5 | 71 |
| The period | | | | 19,900 |

## TENAYA CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904, by A. E. Chandler and N. W. Currie. It is located by the wagon bridge, about 2 miles from Yosemite, Cal.

The channel is straight for 200 feet above and below the station. Both banks are above high water. The bed of the stream is composed of small granite fragments and is not subject to change.

Discharge measurements are made from the bridge. The initial point for soundings is the stream face of the abutment on the right bank.

The gage is a vertical timber securely fastened to the bridge stringer on upper side of bridge, 9 feet from left abutment. The bench mark is formed by the heads of two nails in the top of the bridge stringer near the gage; elevation, 12.70 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Tenaya Creek in Yosemite Valley, California, in 1905.*

| Date. | Hydrographer | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| June 7 | W. B. Clapp | 45 | 119 | 3.36 | 5.95 | 400 |
| June 14 | N. W. Currie | 45 | 125 | 3.42 | 6.00 | 428 |
| June 19 | do | 45 | 110 | 3.03 | 5.65 | 333 |
| June 24 | do | 45 | 90 | 2.46 | 5.18 | 221 |
| June 28 | do | 45 | 72 | 2.01 | 4.80 | 145 |
| July 5 | do | 42 | 51 | 1.59 | 4.40 | 81 |
| July 12 | do | 41 | 37 | 1.19 | 4.10 | 44 |
| July 24 | do | 34 | 16.8 | .84 | 3.60 | 14.1 |
| October 1[a] | do | | | | 3.35 | 3 |

[a] Estimated.

*Daily gage height, in feet, of Tenaya Creek in Yosemite Valley, California, for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.9 | 4.7 | 3.5 | 3.35 | 3.35 | 17 | 5.8 | 3.85 | 3.38 | 3.35 | [a]3.35 |
| 2 | 5.9 | 4.6 | 3.5 | 3.35 | [a]3.35 | 18 | 5.75 | 3.8 | 3.38 | [a]3.35 | [a]3.35 |
| 3 | 5.9 | 4.5 | 3.5 | 3.35 | [a]3.35 | 19 | 5.65 | 3.75 | 3.38 | [a]3.35 | [a]3.35 |
| 4 | 5.7 | 4.4 | 3.45 | 3.35 | [a]3.35 | 20 | 5.55 | 3.7 | 3.38 | [a]3.35 | [a]3.35 |
| 5 | 5.6 | 4.4 | 3.45 | 3.35 | [a]3.35 | 21 | 5.55 | 3.7 | 3.38 | [a]3.35 | 3.35 |
| 6 | 5.7 | 4.35 | 3.4 | 3.35 | [a]3.35 | 22 | 5.5 | 3.65 | 3.38 | [a]3.35 | ...... |
| 7 | 6.0 | 4.3 | 3.4 | 3.35 | 3.35 | 23 | 5.3 | 3.6 | 3.38 | 3.35 | ...... |
| 8 | 5.8 | 4.25 | 3.4 | 3.35 | [a]3.35 | 24 | 5.18 | 3.6 | 3.38 | 3.35 | ...... |
| 9 | 5.75 | 4.2 | 3.4 | 3.35 | [a]3.35 | 25 | 5.1 | 3.6 | 3.38 | [a]3.35 | ...... |
| 10 | 6.0 | 4.1 | 3.4 | 3.35 | 3.35 | 26 | 5.0 | 3.55 | 3.38 | [a]3.35 | ...... |
| 11 | 6.01 | 4.1 | 3.38 | 3.35 | [a]3.35 | 27 | 4.9 | 3.55 | 3.38 | [a]3.35 | ...... |
| 12 | 6.0 | 4.1 | 3.38 | 3.35 | [a]3.35 | 28 | 4.83 | 3.55 | 3.38 | [a]3.35 | ...... |
| 13 | 6.15 | 4.0 | 3.38 | 3.35 | [a]3.35 | 29 | 4.8 | 3.5 | 3.35 | [a]3.35 | ...... |
| 14 | 5.98 | 3.95 | 3.38 | 3.35 | 3.35 | 30 | 4.7 | 3.5 | 3.35 | 3.35 | ...... |
| 15 | 5.95 | 3.9 | 3.38 | 3.35 | 3.35 | 31 | ...... | 3.5 | 3.35 | ...... | ...... |
| 16 | 5.9 | 3.85 | 3.38 | 3.35 | [a]3.35 | | | | | | |

[a] Gage heights estimated.

*Station rating table for Tenaya Creek in Yosemite Valley, California, from July 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.40 | 4.5 | 4.20 | 54 | 5.00 | 184 | 5.80 | 368 |
| 3.50 | 8 | 4.30 | 66 | 5.10 | 204 | 5.90 | 395 |
| 3.60 | 12 | 4.40 | 80 | 5.20 | 225 | 6.00 | 422 |
| 3.70 | 17 | 4.50 | 95 | 5.30 | 247 | 6.10 | 450 |
| 3.80 | 22 | 4.60 | 111 | 5.40 | 270 | 6.20 | 480 |
| 3.90 | 28 | 4.70 | 128 | 5.50 | 293 | 6.30 | 512 |
| 4.00 | 35 | 4.80 | 146 | 5.60 | 317 | | |
| 4.10 | 44 | 4.90 | 165 | 5.70 | 342 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904-5. It is well defined between gage heights 3.3 feet and 6 feet.

*Estimated monthly discharge of Tenaya Creek in Yosemite Valley, California, for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| July 11-31 | 80 | 17 | 38.3 | 1,595 |
| August | 28 | 4.5 | 12.3 | 756 |
| September 1-24 | 80 | 3.9 | 8.6 | 409 |
| 1905. | | | | |
| May 23-31 | 512 | 368 | 425 | 7,587 |
| June | 465 | 128 | 323 | 19,220 |
| July | 128 | 8 | 38.8 | 2,386 |
| August | 8 | 3 | 4.4 | 270 |
| September | 3 | 3 | 3.0 | 179 |
| October 1-21 | 3 | 3 | 3.0 | 125 |
| The period | | | | 29,770 |

### MISCELLANEOUS MEASUREMENTS IN MERCED RIVER DRAINAGE BASIN.

*Bridal Veil Creek, Yosemite Valley, California.*—This stream is a tributary of the Merced River. An estimate was made of the discharge at a point 500 feet above its junction with Merced River and about 1,000 feet below Bridal Veil Falls on June 7, 1905, by W. B. Clapp. It was impossible to make a measurement on account of the rough bed and heavy grade of the stream.

Estimated discharge, 100 second-feet.

*Cascade Creek, Yosemite Valley, California.*—This stream is a tributary of the Merced River. An estimate was made of the discharge at a point 500 feet below Cascade Falls near mouth of creek on June 6, 1905, by W. B. Clapp.

Estimated discharge, 150 second-feet.

*Ribbon Falls Creek, Yosemite Valley, California.*—This stream is tributary to Merced River in Yosemite Valley. A measurement was made where the creek crosses the road on the west side of the valley on June 7 by W. B. Clapp.

The stream was flowing in several shallow channels.

Total width, 20.5 feet; area, 9.0 square feet; mean velocity, 1.89 feet per second; discharge, 17.0 second-feet.

## TUOLUMNE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Tuolumne River rises on the western slope of the Sierra Nevada and drains the country located between Stanislaus River on the north and Merced River on the south. It has numerous tributaries, several of which produce a heavy discharge. The country throughout this basin is rough and rugged, especially along the main river, which cuts through solid granite, with high precipitous cliffs on either side. Along this stream is found some of the grandest scenery of the Sierra Nevada. This stream drains the northern portion of the Yosemite National Park, where is located the Grand Canyon of the Tuolumne and the Hetch Hetchy Valley, which is pronounced by many to exceed the famed Yosemite Valley in grandeur and beauty. The formation is of granite, which on the higher elevations is bare and glaciated, often rising thousands of feet in vertical cliffs and domes. Along the middle reaches of this basin there is good soil covering, with a heavy timber growth of pine, fir, cedar, and other kindred trees. On the lower reaches the covering is a heavy growth of brush, which diminishes in the foothills where the stream enters the San Joaquin Valley. This portion of the basin has a light soil covering, with grass growth, which is used for pasturage. There are several glacial lakes throughout the upper reaches of this basin, many of the larger of which offer exceptional opportunities for the construction of storage reservoirs. There are also many reservoir sites on the main river. The stream has a heavy fall, and the opportunities for power development are numerous. Several diversions are made above the gaging station, which is located at Lagrange, where the stream breaks from the foothills. The precipitation on the upper half of this basin falls in the form of snow, a greater portion of which disappears in the spring months, but on the higher elevations remains until late in the summer. The mean annual rainfall varies from about 30 inches on the lower foothills to about 60 inches on the higher elevations.

### TUOLUMNE RIVER AT LAGRANGE, CAL.

This station was established August 29, 1895, by J. B. Lippincott. It is located at the wagon bridge, in the town of Lagrange. It is below the high dam, where the diversions are made by the Turlock and Modesto canals, and also below the head of the canal of the Lagrange Ditch and Hydraulic Mining Company, which diverts water from the left bank of the river above the dam.

The channel is straight for 400 feet above and 600 feet below the station. It is broken by two iron piers and has a width at ordinary stages of 300 feet. During the season of low flow all the water is taken out by the Turlock and Modesto canals above the station. The record of flow of these canals is kept. The bed of the stream is composed of gravel and is fairly permanent. The current is swift at high stages and very sluggish during low water. The discharge has gradually increased each year for the same gage heights. Both banks are high and not subject to overflow.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is a mark on the railing of the bridge 100 feet north from the center of first pier on right bank of the river.

The gage is a vertical timber fastened to the right abutment of the bridge. During 1905 the gage was read by R. A. Trumbly. Bench marks were established as follows: (1) Top of a rock marked with white paint, situated on the left bank below the bridge and opposite the 573 foot mark of the cross section; elevation, 19.10 feet. (2) The top of rock marked with white paint, situated 75 feet downstream from bench mark No. 1; elevation, 16.89 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Tuolumne River at Lagrange, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 15 | F. R. S. Buttemer | 325 | 1,426 | 1.79 | 6.10 | 2,548 |
| April 6 | O. W. Patterson | 332 | 1,591 | 2.40 | 6.60 | 3,817 |
| May 24 | R. S. Hawley | 344 | 2,068 | 3.79 | 7.90 | 7,846 |
| June 16 | do | 344 | 2,068 | 3.66 | 7.90 | 7,574 |
| June 17 | do | 344 | 1,906 | 3.28 | 7.45 | 6,249 |
| September 13 | C. H. Lee | 30 | 20 | .45 | 3.30 | 9.2 |
| October 18 | Lee and Hawley | 38 | 36 | 1.47 | 3.68 | 53 |

*Daily gage height, in feet, of Tuolumne River at Lagrange, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.7 | 5.75 | 5.7 | 5.9 | 7.3 | 7.0 | 6.05 | 3.2 | 3.1 | 3.7 | 3.65 | 4.05 |
| 2 | 5.1 | 8.1 | 5.85 | 6.05 | 6.7 | 7.0 | 6.0 | 3.2 | 3.1 | 3.85 | 3.65 | 4.05 |
| 3 | 5.0 | 6.3 | 5.9 | 5.9 | 6.3 | 6.9 | 5.8 | 3.2 | 3.1 | 3.8 | 3.65 | 4.0 |
| 4 | 4.8 | 6.0 | 5.9 | 5.9 | 6.35 | 6.85 | 5.45 | 3.2 | 3.1 | 3.7 | 3.65 | 4.0 |
| 5 | 4.8 | 6.35 | 5.9 | 5.95 | 6.15 | 6.75 | 5.5 | 3.2 | 3.1 | 3.6 | 3.65 | 4.0 |
| 6 | 4.8 | 6.1 | 5.9 | 6.3 | 6.15 | 6.7 | 5.5 | 3.2 | 3.1 | 3.6 | 3.65 | 4.0 |
| 7 | 4.75 | 5.6 | 5.9 | 6.65 | 6.35 | 6.85 | 5.35 | 3.2 | 3.1 | 3.6 | 3.65 | 4.0 |
| 8 | 4.75 | 5.5 | 5.9 | 6.6 | 6.5 | 7.1 | 5.4 | 3.2 | 3.1 | 3.6 | 3.65 | 4.0 |
| 9 | 4.75 | 5.4 | 5.85 | 6.45 | 6.2 | 7.6 | 5.15 | 3.2 | 3.1 | 3.5 | 3.65 | 4.0 |
| 10 | 4.75 | 5.4 | 5.8 | 6.5 | 6.1 | 7.9 | 5.0 | 3.2 | 3.1 | 3.5 | 3.65 | 4.0 |
| 11 | 4.8 | 5.2 | 5.85 | 6.4 | 6.0 | 8.0 | 4.85 | 3.2 | 3.1 | 3.5 | 3.65 | 3.9 |
| 12 | 4.8 | 5.1 | 5.8 | 6.05 | 6.0 | 8.05 | 4.7 | 3.2 | 3.4 | 3.5 | 3.65 | 3.9 |
| 13 | 4.8 | 5.1 | 6.95 | 5.8 | 5.9 | 8.0 | 4.55 | 3.2 | 3.3 | 3.5 | 3.65 | 4.0 |
| 14 | 4.8 | 5.0 | 6.55 | 5.75 | 6.1 | 7.85 | 4.5 | 3.2 | 3.3 | 3.5 | 3.7 | 3.95 |
| 15 | 4.8 | 5.0 | 6.1 | 5.9 | 6.8 | 7.85 | 4.75 | 3.2 | 3.2 | 3.5 | 3.7 | 3.95 |
| 16 | 4.8 | 4.9 | 6.1 | 5.95 | 7.7 | 7.8 | 4.7 | 3.2 | 3.2 | 3.5 | 3.7 | 3.95 |
| 17 | 4.8 | 5.1 | 7.3 | 5.9 | 8.7 | 7.6 | 3.65 | 3.2 | 3.2 | 3.5 | 3.7 | 4.0 |
| 18 | 4.8 | 5.1 | 7.0 | 5.95 | 8.25 | 7.45 | 3.4 | 3.1 | 3.2 | 3.6 | 3.7 | 4.0 |
| 19 | 4.8 | 5.1 | 9.3 | 5.9 | 8.0 | 7.3 | 3.3 | 3.1 | 3.2 | 3.65 | 3.7 | 4.0 |
| 20 | 4.85 | 5.85 | 7.6 | 5.9 | 8.0 | 7.25 | 3.2 | 3.1 | 3.2 | 3.65 | 3.75 | 4.05 |
| 21 | 5.0 | 5.65 | 6.85 | 5.9 | 8.25 | 7.35 | 3.2 | 3.1 | 3.2 | 3.7 | 3.8 | 4.15 |
| 22 | 5.1 | 5.4 | 6.6 | 5.95 | 7.9 | 6.9 | 3.2 | 3.1 | 3.2 | 3.7 | 3.75 | 4.1 |
| 23 | 5.15 | 5.4 | 6.5 | 6.6 | 7.6 | 6.25 | 3.2 | 3.1 | 3.2 | 3.7 | 3.75 | 4.05 |
| 24 | 5.2 | 5.4 | 6.3 | 7.1 | 7.8 | 6.15 | 3.2 | 3.1 | 3.2 | 3.7 | 3.75 | 4.05 |
| 25 | 5.1 | 5.55 | 6.1 | 7.1 | 8.0 | 6.15 | 3.2 | 3.1 | 3.2 | 3.7 | 3.8 | 4.05 |
| 26 | 5.0 | 5.8 | 6.1 | 7.2 | 7.85 | 6.1 | 3.2 | 3.1 | 3.2 | 3.7 | 3.8 | 4.0 |
| 27 | 4.85 | 5.7 | 6.2 | 7.2 | 7.65 | 6.05 | 3.2 | 3.1 | 3.3 | 3.7 | 3.85 | 4.0 |
| 28 | 4.8 | 5.8 | 6.1 | 7.35 | 7.35 | 6.05 | 3.2 | 3.1 | 3.25 | 3.7 | 4.0 | 4.1 |
| 29 | 4.8 | ....... | 6.45 | 7.4 | 6.7 | 6.20 | 3.2 | 3.1 | 3.4 | 3.65 | 4.0 | 4.15 |
| 30 | 4.9 | ....... | 6.25 | 7.7 | 6.85 | 6.05 | 3.2 | 3.1 | 3.5 | 3.65 | 4.05 | 4.15 |
| 31 | 4.9 | ....... | 6.1 | ....... | 6.9 | ....... | 3.2 | 3.1 | ....... | 3.65 | ....... | 4.2 |

*Station rating table for Tuolumne River at Lagrange, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.10 | 1 | 4.50 | 340 | 5.90 | 2,200 | 7.60 | 6,700 |
| 3.20 | 5 | 4.60 | 410 | 6.00 | 2,400 | 7.80 | 7,360 |
| 3.30 | 10 | 4.70 | 490 | 6.10 | 2,610 | 8.00 | 8,060 |
| 3.40 | 20 | 4.80 | 580 | 6.20 | 2,830 | 8.20 | 8,780 |
| 3.50 | 30 | 4.90 | 680 | 6.30 | 3,060 | 8.40 | 9,500 |
| 3.60 | 40 | 5.00 | 790 | 6.40 | 3,300 | 8.60 | 10,260 |
| 3.70 | 55 | 5.10 | 910 | 6.50 | 3,550 | 8.80 | 11,050 |
| 3.80 | 70 | 5.20 | 1,030 | 6.60 | 3,800 | 9.00 | 11,850 |
| 3.90 | 90 | 5.30 | 1,170 | 6.70 | 4,060 | 9.20 | 12,660 |
| 4.00 | 120 | 5.40 | 1,310 | 6.80 | 4,320 | 9.40 | 13,480 |
| 4.10 | 150 | 5.50 | 1,470 | 6.90 | 4,600 | 9.60 | 14,320 |
| 4.20 | 190 | 5.60 | 1,630 | 7.00 | 4,880 | 9.80 | 15,160 |
| 4.30 | 230 | 5.70 | 1,810 | 7.20 | 5,470 | 10.00 | 16,000 |
| 4.40 | 280 | 5.80 | 2,000 | 7.40 | 6,070 | | |

*Estimated monthly discharge of Tuolumne River at Lagrange, Cal., for 1905.*

[Drainage area, 1,501 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,810 | 535 | 745 | 45,810 | 0.496 | 0.572 |
| February | 8,420 | 745 | 1,926 | 107,000 | 1.28 | 1.33 |
| March | 13,070 | 1,871 | 3,487 | 214,400 | 2.32 | 2.68 |
| April | 7,770 | 2,696 | 4,016 | 239,000 | 2.68 | 2.99 |
| May | 11,360 | 2,866 | 5,927 | 364,400 | 3.95 | 4.55 |
| June | 9,075 | 3,258 | 5,969 | 355,200 | 3.98 | 4.44 |
| July | 3,403 | 427 | 1,344 | 82,640 | .895 | 1.03 |
| August | 345 | 103 | 212 | 13,040 | .141 | .163 |
| September | 131 | [a] 8 | 78.1 | 4,647 | .052 | .058 |
| October | 80 | 30 | 45.5 | 2,798 | .030 | .035 |
| November | 135 | 48 | 62.2 | 3,701 | .041 | .046 |
| December | 190 | 90 | 129 | 7,932 | .086 | .099 |
| The year | 13,070 | 8 | 1,995 | 1,441,000 | 1.33 | 17.99 |

[a] The minimum of 8 feet in September was caused by closing head-gate of Turlock Canal and holding water back in reservoir until dam overflowed.

NOTE.—The above discharge includes that of Turlock and Modesto canals.

## MODESTO CANAL AT LAGRANGE, CAL.

The Modesto canal is the property of the Modesto irrigation district. The water is diverted from the right side of the Tuolumne River at the Lagrange dam. This canal was designed to carry 660 second-feet and to irrigate land in the vicinity of Modesto, Stanislaus County, Cal. The principal part of the construction work was done on this canal prior to 1892, but on account of litigation the canal was not completed until April, 1903.

On April 26, 1903, a gage rod was set in and a rating made of Indian Hill flume, near Lagrange, Cal. From May 10 to June 3 and from June 10 to June 25, inclusive, boards were placed in the flumes to back the water up and keep the flumes saturated. During this time gage heights were obtained by taking the depth of the water in the canal below Indian Hill flume.

On July 12, 1904, the station was moved to the flume near the intake. This was done so that more gage readings and explanations of their fluctuations could be obtained by having J. L. Montgomery, the regulator of the gates at the intake, act as gage observer. This flume is 11.85 feet in width.

Information in regard to this station is contained in Water-Supply Papers Nos. 100 and 134 of the United States Geological Survey.

*Discharge measurements of Modesto canal at Lagrange, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 6 | O. W. Peterson | 11.8 | 40 | 7.28 | 3.40 | 291 |
| May 24 | R. S. Hawley | 11.8 | 37 | 6.68 | 3.15 | 247 |
| June 17 | do | 11.8 | 45 | 7.18 | 3.85 | 323 |
| July 21 | do | 12 | 35 | 6.34 | 2.95 | 222 |

*Daily gage height, in feet, of Modesto canal at Lagrange, Cal., for 1905.*

| Day. | Jan | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0 | 2.8 | [a] 1.2 | 2.6 | 3.0 | 3.5 | 4.0 | 1.7 | 1.0 |
| 2 | 0 | [b] 0 | 1.2 | 2.9 | 3.0 | 3.5 | 4.0 | 1.8 | .95 |
| 3 | 0 | [a] 1.3 | 1.2 | 3.1 | 3.0 | 3.5 | [b] 0 | 1.8 | .95 |
| 4 | 0 | 2.0 | 1.2 | 3.2 | 3.0 | 3.5 | [a] 2.5 | 1.6 | .95 |
| 5 | 0 | 2.1 | 1.2 | 3.3 | 3.0 | 3.5 | 3.5 | 1.65 | .95 |
| 6 | 0 | 2.0 | 1.25 | 3.3 | 3.0 | 3.5 | 4.0 | 1.65 | .8 |
| 7 | 0 | 1.95 | 1.25 | 3.3 | 3.0 | 3.6 | 4.0 | 1.4 | .85 |
| 8 | 0 | 2.45 | 1.25 | 3.2 | 3.0 | 3.6 | 4.0 | 1.55 | .8 |
| 9 | 0 | 2.8 | 1.25 | 3.2 | 3.0 | 3.6 | 4.5 | 1.55 | .8 |
| 10 | 0 | 3.0 | 1.25 | 3.1 | 3.0 | 3.6 | 4.5 | 1.4 | .8 |
| 11 | 0 | 3.0 | 1.25 | 3.2 | 3.0 | 2.5 | 4.5 | 1.5 | .4 |
| 12 | 0 | 3.1 | .85 | 3.2 | 3.0 | 3.5 | 4.0 | 1.4 | ........ |
| 13 | 0 | 3.2 | .5 | 3.2 | 3.0 | 2.75 | 4.0 | 1.4 | ........ |
| 14 | 0 | 3.3 | .7 | 3.1 | 3.0 | 3.7 | 4.0 | 1.4 | ........ |
| 15 | 0 | 3.3 | .7 | 3.0 | 3.0 | 3.7 | 4.0 | 1.3 | ........ |
| 16 | [a] 1.0 | 3.3 | .7 | 3.0 | 3.0 | 3.7 | 4.0 | 1.3 | ........ |
| 17 | .9 | 3.3 | .8 | 3.0 | 3.0 | 3.7 | 4.0 | 1.3 | ........ |
| 18 | .9 | 3.3 | .8 | 3.0 | 3.0 | 3.75 | 4.0 | 1.3 | ........ |
| 19 | .9 | 3.3 | [b] 0 | 3.0 | 3.0 | 3.75 | 3.0 | 1.25 | ........ |
| 20 | .9 | 3.0 | 0 | 3.0 | 3.2 | 3.75 | 3.0 | 1.0 | ........ |
| 21 | 1.05 | 2.7 | 0 | 3.0 | 3.2 | 3.8 | 2.9 | 1.1 | ........ |
| 22 | 1.05 | 3.3 | [a] 2.0 | 3.0 | [b] 0 | 3.9 | 2.9 | 1.15 | ........ |
| 23 | 1.05 | 3.0 | 2.1 | 3.0 | 0 | 3.9 | 2.5 | 1.15 | ........ |
| 24 | 1.05 | 2.75 | 2.5 | 3.0 | [a] 3.15 | 4.0 | 2.5 | 1.15 | ........ |
| 25 | 1.05 | 2.75 | 2.5 | 3.0 | 3.3 | 1.75 | 2.75 | 1.15 | ........ |
| 26 | 1.6 | [b] 0 | 2.8 | 3.0 | 3.35 | 1.55 | 2.7 | 1.15 | ........ |
| 27 | 2.0 | 0 | [b] 0 | 3.0 | 3.35 | 4.0 | 2.55 | 1.1 | ........ |
| 28 | 2.05 | 0 | 0 | 3.0 | 3.5 | 4.0 | 2.4 | .9 | ........ |
| 29 | 2.05 | ........ | 0 | 3.0 | 3.5 | 4.0 | 2.55 | .9 | ........ |
| 30 | 2.35 | ........ | [a] 1.5 | 3.0 | 3.5 | 4.0 | 2.1 | .9 | ........ |
| 31 | 2.7 | ........ | 2.0 | ........ | 3.5 | ........ | 2.1 | 1.0 | ........ |

[a] Water turned in.

[b] Water turned out.

**Note.**—Canal dry September 12 to December 31.

*Station rating table for Modesto canal at Lagrange, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.10 | 2 | 1.10 | 53 | 2.10 | 140 | 3.20 | 252 |
| 20 | 4 | 1.20 | 61 | 2.20 | 150 | 3.40 | 274 |
| 30 | 7 | 1.30 | 69 | 2.30 | 160 | 3.60 | 296 |
| 40 | 11 | 1.40 | 77 | 2.40 | 170 | 3.80 | 318 |
| 50 | 16 | 1.50 | 85 | 2.50 | 180 | 4.00 | 340 |
| 60 | 21 | 1.60 | 94 | 2.60 | 190 | 4.20 | 364 |
| 70 | 26 | 1.70 | 103 | 2.70 | 200 | 4.40 | 388 |
| 80 | 32 | 1.80 | 112 | 2.80 | 210 | | |
| 90 | 38 | 1.90 | 121 | 2.90 | 220 | | |
| 1.00 | 45 | 2.00 | 130 | 3.00 | 230 | | |

NOTE.—The above table is based on discharge measurements made during 1904–1905. It is well defined between gage heights 0.5 foot and 4 feet. Monthly estimates are included with those of Tuolumne River, p. 210.

## TURLOCK CANAL AT LAGRANGE, CAL.

The Turlock canal, the property of the Turlock irrigation district, takes water from the left bank of the Tuolumne River at the Lagrange dam. This canal was designed to carry 1,500 second-feet and to irrigate a large area of fertile land in the vicinity of Turlock and Ceres, Stanislaus County, Cal.

During 1898 water was first turned into the canal in small quantities and used for puddling the banks. A record of the gage height has been kept since July, 1899. Meter measurements are made when the gaging station on the Tuolumne River at Lagrange is visited, and Morgan flume, or flume No. 2, has been rated. It is 13.75 feet in width.

In the spring of 1905 a station was established in flume No. 1 and used for some time, but it did not give satisfactory results during high stages of the canal. Gage readings were discontinued on this flume and resumed on the Morgan flume. The record since May 22, 1905, is on the Morgan flume. The observer is J. J. R. Johnson, the canal tender.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Turlock canal at Lagrange, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| April 8 | O. W. Peterson | 19.5 | 24 | 1.96 | 1.22 | 47 |
| April 8 | do | 19.5 | 40 | 3.20 | 2.05 | 128 |
| April 8 | do | 19.5 | 55 | 3.82 | 2.80 | 210 |
| April 8 | do | 19.5 | 81 | 4.60 | 4.15 | 375 |
| May 24 | R. S. Hawley | 13.8 | 72 | 7.13 | 5.30 | 514 |
| June 17 | do | 13.8 | 76 | 7.58 | 5.55 | 576 |
| July 21 | do | 13.8 | 66 | 6.55 | 4.65 | 432 |
| September 14 | C. H. Lee | 13.6 | 28 | 3.07 | 2.04 | 86 |

NOTE.—Measurements on April 8 were made on little flume near head of canal, others made at Morgan flume.

*Daily gage height, in feet, of Turlock canal at Lagrange, Cal., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | ........ | 4.15 | 5.3 | 5.4 | 5.55 | 3.1 | 2.0 |
| 2 | ........ | 4.1 | 5.3 | 5.4 | 5.6 | 3.2 | 2.0 |
| 3 | ........ | 4.1 | 5.4 | 5.4 | 5.6 | 3.15 | 1.9 |
| 4 | ........ | 4.15 | 5.2 | 5.4 | 5.6 | 2.9 | 1.9 |
| 5 | ........ | 4.2 | 5.2 | 5.4 | 5.6 | 2.95 | 1.9 |
| 6 | ........ | 0 | 5.2 | 5.4 | 5.6 | 2.95 | 1.8 |
| 7 | ........ | 0 | 4.1 | 5.4 | 5.6 | 2.65 | 1.8 |
| 8 | ........ | 3.2 | 4.6 | 5.4 | 5.6 | 2.65 | 1.65 |
| 9 | ........ | 3.0 | 4.7 | 5.4 | 5.6 | 2.65 | 1.65 |
| 10 | ........ | 1.5 | 4.7 | 5.45 | 5.6 | 2.65 | 1.65 |
| 11 | ........ | 4.6 | 4.7 | 5.4 | 5.6 | 2.65 | 1.65 |
| 12 | ........ | 4.7 | 4.7 | 5.5 | 5.6 | 2.6 | 1.65 |
| 13 | ........ | 4.8 | 4.7 | 5.5 | 5.6 | 2.7 | 1.8 |
| 14 | ........ | 5.5 | 4.75 | 5.5 | 5.6 | 2.4 | 2.5 |
| 15 | ........ | 5.5 | 4.85 | 5.5 | 3.6 | 2.4 | 2.1 |
| 16 | ........ | 5.5 | 4.9 | 5.5 | 5.6 | 2.4 | 2.1 |
| 17 | ........ | 5.5 | 5.0 | 5.5 | 5.2 | 2.4 | 1.8 |
| 18 | ........ | 5.5 | 5.0 | 5.55 | 5.4 | 2.4 | 1.8 |
| 19 | ........ | 5.2 | 5.0 | 5.5 | 5.0 | 2.4 | 1.7 |
| 20 | ........ | 5.2 | 0 | 5.5 | 5.0 | 2.0 | 1.75 |
| 21 | ........ | 5.3 | 0 | 5.5 | 4.8 | 2.15 | 1.75 |
| 22 | 1.6 | 5.2 | 5.3 | 5.5 | 4.8 | 2.2 | 1.75 |
| 23 | 2.1 | 5.25 | 5.25 | 5.5 | 4.2 | 2.2 | 1.75 |
| 24 | 2.1 | 5.25 | 5.25 | 5.5 | 4.55 | 2.2 | 1.75 |
| 25 | 3.0 | 5.25 | 5.3 | 5.55 | 4.55 | 2.2 | 1.75 |
| 26 | 3.4 | 5.2 | 5.4 | 5.55 | 4.5 | 2.2 | 1.75 |
| 27 | 4.1 | 5.3 | 5.4 | 5.55 | 4.25 | 2.2 | ........ |
| 28 | 4.1 | 5.4 | 5.4 | 5.55 | 4.0 | 1.8 | ........ |
| 29 | 2.1 | 5.3 | 5.4 | 5.6 | 4.1 | 1.8 | ........ |
| 30 | 4.1 | 5.3 | 5.4 | 5.55 | 3.6 | 1.8 | ........ |
| 31 | 4.0 | ........ | 5.4 | ........ | 3.6 | 2.0 | ........ |

NOTE.—Canal dry January 1 to March 21 and September 26 to December 31.

*Station rating table for Turlock canal at Lagrange, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 1 | 1.50 | 40 | 2.70 | 166 | 3.90 | 324 |
| 40 | 2 | 1.60 | 47 | 2.80 | 178 | 4.00 | 338 |
| 50 | 3 | 1.70 | 55 | 2.90 | 190 | 4.20 | 366 |
| 60 | 4 | 1.80 | 64 | 3.00 | 202 | 4.40 | 394 |
| 70 | 5 | 1.90 | 74 | 3.10 | 215 | 4.60 | 422 |
| 80 | 7 | 2.00 | 85 | 3.20 | 228 | 4.80 | 450 |
| 90 | 10 | 2.10 | 96 | 3.30 | 241 | 5.00 | 478 |
| 1.00 | 14 | 2.20 | 107 | 3.40 | 254 | 5.20 | 506 |
| 1.10 | 18 | 2.30 | 118 | 3.50 | 268 | 5.40 | 535 |
| 1.20 | 23 | 2.40 | 130 | 3.60 | 282 | 5.60 | 565 |
| 1.30 | 28 | 2.50 | 142 | 3.70 | 296 | | |
| 1.40 | 34 | 2.60 | 154 | 3.80 | 310 | | |

NOTE.—The above table is based on discharge measurements made during 1904-5. It is well defined between gage heights 2 feet and 5.5 feet. Monthly estimates are included with those of Tuolumne River, p. 210.

## MISCELLANEOUS MEASUREMENTS IN TUOLUMNE RIVER DRAINAGE BASIN.

*Clavey River.*—This stream is tributary to Tuolumne River from the north and enters it about 10 miles above the mouth of the North Fork. A measurement was made on September 15, 1905, just above the bridge for the new trail from Tuolumne to Lake Eleanor, by H. A. Campbell.

Width, 10 feet; area, 14.3 square feet; mean velocity, 0.87 foot per second; discharge, 12.5 second-feet.

*Cherry River.*—This stream is tributary to the Tuolumne River from the north and enters it about 15 miles below Hetch Hetchy Valley. A measurement was made one-third of a mile above the mouth of Eleanor Creek on September 16, 1905, by H. A. Campbell.

Width, 2 feet; area, 1.4 square feet; mean velocity, 1.00 foot per second; discharge, 1.4 second-feet.

*Cherry River at Cherry Valley, Cal.*—A measurement was made at the old gaging station in the lower end of Cherry Valley on main trail from Tuolumne to Lake Eleanor on September 17, 1905, by H. A. Campbell.

Width, 2.2 feet; area, 1.6 square feet; mean velocity, 0.58 foot per second; discharge, 0.92 second-foot.

*Eleanor Creek.*—A measurement was made on September 18, 1905, 1 mile below outlet from Lake Eleanor and about 3 miles above its junction with Cherry Creek, by H. A. Campbell.

Width, 2.0 feet; area, 0.50 square foot; mean velocity, 0.60 foot per second; discharge, 0.30 second-foot.

*Tuolumne River at Hetch Hetchy, Cal.*—A measurement was made on September 18, 1905, at the head of Hetch Hetchy Valley, one-half mile above mouth of Rancheria Creek, by H. A. Campbell.

Width, 14 feet; area, 12 square feet; mean velocity, 1.83 feet per second; discharge, 22 second-feet.

*Rancheria Creek.*—This stream enters Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, 100 yards above trail crossing, about 1½ miles above its junction with Tuolumne River, by H. A. Campbell.

Width, 4 feet; area, 3.3 square feet; mean velocity, 0.94 foot per second; discharge, 3.1 second-feet.

*Tiltill Creek.*—This stream enters the Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, at lower end of Tiltill Valley about 2 miles above its junction with Tuolumne River, by H. A. Campbell.

Width, 0.9 foot; area, 0.18 square foot; mean velocity, 0.67 foot per second; discharge, 0.12 second-foot.

*Falls Creek.*—This stream enters Tuolumne River from the north in Hetch Hetchy Valley. A measurement was made on September 19, 1905, at the outlet of Lake Vernon, by H. A. Campbell.

Width, 4.4 feet; area, 1.6 square feet; mean velocity, 0.75 foot per second; discharge, 1.2 second-feet.

*Tuolumne River at Hetch Hetchy Valley, Cal.*—A measurement was made on September 21, 1905, at the lower end of Hetch Hetchy Valley about one-half mile below trail to Lake Eleanor, by H. A. Campbell.

Width, 18.5 feet; area, 13.5 square feet; mean velocity, 1.78 feet per second; discharge, 24 second-feet.

*Middle Fork of Tuolumne River.*—A measurement was made on this stream on September 21, 1905, about 100 yards downstream from the bridge on the road from Sequoia to Hog Ranch by H. A. Campbell.

Width, 2 feet; area, 0.60 square foot; mean velocity, 0.93 foot per second; discharge, 0.56 second-foot.

*South Fork of Tuolumne River.*—A measurement was made on this stream on September 22, 1905, about 75 yards upstream from the bridge on the Big Oak Flat and Yosemite Toll Road, near Harden ranch, by H. A. Campbell.

Width, 11.2 feet; area, 10.6 square feet; mean velocity, 0.42 foot per second; discharge, 4.5 second-feet.

*Mining ditch near Lagrange, Cal.*—This ditch diverts water from the Tuolumne River several miles above the town of Lagrange, Cal. A measurement was made April 6 at a point on the hill above the Lagrange dam.

Width, 6 feet; area, 4.3 square feet; mean velocity, 1.58 feet per second; discharge, 6.8 second-feet.

## STANISLAUS RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Stanislaus River drains a portion of the western slope of the Sierra Nevada and heads well back on the crest, at elevations of from 10,000 to 12,000 feet. It drains the country between the basins of the Mokelumne River on the north and the Tuolumne River on the south, and flows in a general southwesterly direction, entering the San Joaquin River 23 miles above Stockton. It has numerous tributaries in the upper reaches of the basin, which have their source in numerous small glacial lakes. The topography is rough and broken with high mountain peaks. The formation is of granite, which is bare and destitute of timber growth above an elevation of 8,000 feet, except where small glacial lakes and moraines occur. In the middle reaches of the basin there is good soil covering and a heavy growth of timber. In this basin is situated the Calaveras grove of big trees (*Sequoia gigantea*), for which the Sierra Nevada are famous. This is the most northerly grove of these trees, groves of which extend as far south as the Kern River basin. The mean annual rainfall for the basin is about 50 inches. The precipitation falls chiefly in the form of snow on the higher elevations, remaining well into the summer months. Mining operations have been carried on extensively in this basin, and many canals have been taken out of the river, all of which discharge their water into the river again. The canal of the Stanislaus Water Company diverts water 3 miles above Knights Ferry, which is used to irrigate land between Knights Ferry and Stockton. A gaging station is maintained on this canal to determine its discharge.

### STANISLAUS RIVER AT KNIGHTS FERRY, CAL.

A station was first established on this river on May 3, 1895, at the railroad bridge one-half mile north of the town of Oakdale. On July 30, 1898, a cable was placed 1,000 feet below the railroad bridge. This station was used until February 16, 1901.

The station at Knights Ferry was established May 19, 1903, by W. H. Stearns. It is located 200 feet from the post-office at Knights Ferry.

There is an island 800 feet above the gaging station, and a dam on each channel at the head of the island. The Stanislaus Milling and Power Company's power house is on the right bank of the river below one of these dams and about 1,000 feet above the gaging station. The channel is straight for 500 feet above and below the cable. At ordinary and high stages the stream has a fall of 0.47 foot in the 500 feet above the cable and of 0.68 foot in the 500 feet below. Both banks are composed of cemented gravel and are high. The left bank is not subject to overflow. In extreme floods the right bank has been known to be overflowed, flooding the yards and houses next to the river. The bed is of gravel and is subject to some change from the addition of material which is washed down from the island above.

Discharge measurements at high and medium stages are made from a car suspended from a cable. Low-water measurements are made by wading 300 feet above the cable. The initial point for soundings is the eyebolt to which the cable is fastened on the right bank.

Ordinary and low-water stages were read on an iron pipe driven into the bed of the stream. For high stages the gage was a plank nailed to a post on the right bank of the river. A new gage rod has been placed near the cable on the right bank and gage readings are now made on this rod. It consists of an inclined rod fastened securely to posts set in the ground. This portion of the rod is used for the lower stages. For high water there is a vertical section similar to the above at the north cable support. During 1905 the gage was read once each day by E. J. Coop. Bench marks were established as follows: (1) A spike in a locust tree 50 feet northeast of right cable support; elevation, 19.20 feet. (2) A rock under the spike at the foot of the above locust tree; elevation, 18.74 feet. Elevations refer to the datum of the new gage.

Information in regard to this station is contained in Water-Supply Papers Nos. 81, 100, and 134 of the United States Geological Survey.

*Discharge measurements of Stanislaus River at Knights Ferry, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 14 | F. R. S. Buttemer | 197 | 751 | 3.36 | 9.15 | 2,523 |
| April 6 | O. W. Peterson | 198 | 769 | 3.49 | 9.25 | 2,687 |
| April 16 | R. S. Hawley | 194 | 771 | 3.27 | 9.30 | 2,518 |
| May 23 | do | 217 | 944 | 4.30 | 10.05 | 4,062 |
| July 20 | do | 148 | 363 | 1.17 | 7.00 | 425 |
| September 12 | Lee and Keeler | 40 | 51 | 1.68 | 6.19 | 86 |
| September 22 | R. W. Keeler | 40 | 49 | 1.57 | 6.11 | 77 |
| September 29 | do | 40 | 49 | 1.63 | 6.17 | 80 |
| October 6 | do | 40 | 49 | 1.69 | 6.14 | 83 |
| October 13 | do | 40 | 48 | 1.77 | 6.19 | 85 |
| October 16 | Lee and Hawley | 40 | 47 | 1.85 | 6.21 | 87 |
| December 21 | R. W. Keeler | 120 | 268 | .53 | 6.41 | 142 |

*Daily gage height, in feet, of Stanislaus River at Knights Ferry, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.4 | 7.75 | 8.25 | 8.55 | 9.8 | 9.45 | 7.95 | 6.4 | 6.15 | 6.1 | 6.1 | 6.45 |
| 2 | 7.3 | 10.15 | 8.4 | 8.7 | 9.5 | 9.35 | 7.8 | 6.4 | 6.15 | 6.1 | 6.1 | 6.3 |
| 3 | 7.25 | 8.4 | 8.45 | 8.85 | 9.35 | 9.25 | 7.7 | 6.4 | 6.15 | 6.15 | 6.1 | 6.25 |
| 4 | 7.15 | 8.05 | 8.55 | 8.95 | 9.1 | 9.0 | 7.65 | 6.4 | 6.15 | 6.15 | 6.1 | 6.3 |
| 5 | 7.1 | 8.85 | 8.5 | 9.1 | 9.0 | 8.8 | 7.6 | 6.35 | 5.7 | 6.15 | 6.1 | 6.3 |
| 6 | 7.05 | 8.45 | 8.5 | 9.25 | 8.85 | 8.85 | 7.45 | 6.3 | 5.7 | 6.1 | 6.1 | 6.3 |
| 7 | 7.0 | 8.1 | 8.5 | 9.4 | 9.4 | 9.2 | 7.45 | 6.3 | 6.2 | 6.1 | 6.1 | 6.3 |
| 8 | 7.0 | 7.85 | 8.45 | 9.4 | 9.35 | 9.2 | 7.45 | 6.25 | 6.2 | 6.1 | 6.1 | 6.3 |
| 9 | 7.15 | 7.8 | 8.4 | 9.4 | 9.1 | 9.1 | 7.45 | 6.25 | 6.15 | 6.1 | 6.1 | 6.3 |
| 10 | 7.2 | 7.7 | 8.4 | 9.45 | 8.95 | 9.15 | 7.4 | 6.25 | 6.1 | 6.1 | 6.15 | 6.3 |
| 11 | 7.1 | 7.65 | 8.45 | 9.15 | 8.8 | 9.4 | 7.3 | 6.25 | 6.1 | 6.1 | 6.2 | 6.3 |
| 12 | 7.05 | 7.6 | 8.4 | 8.95 | 8.75 | 9.65 | 7.3 | 6.25 | 6.15 | 6.1 | 6.2 | 6.3 |
| 13 | 7.0 | 7.45 | 9.1 | 8.9 | 8.75 | 9.65 | 7.2 | 6.2 | 6.15 | 6.1 | 6.2 | 6.3 |
| 14 | 7.0 | 7.4 | 9.0 | 8.95 | 9.05 | 9.5 | 7.1 | 6.2 | 6.15 | 6.1 | 6.2 | 6.3 |
| 15 | 7.1 | 7.4 | 8.55 | 9.1 | 9.5 | 9.3 | 7.0 | 6.25 | 6.2 | 6.15 | 6.2 | 6.3 |
| 16 | 7.4 | 7.4 | 9.1 | 9.25 | 10.15 | 9.4 | 6.9 | 6.2 | 6.2 | 6.2 | 6.2 | 6.3 |
| 17 | 7.3 | 7.7 | 10.35 | 9.05 | 11.2 | 9.25 | 6.85 | 6.2 | 6.2 | 6.15 | 6.2 | 6.25 |
| 18 | 7.3 | 7.8 | 9.6 | 9.2 | 10.55 | 9.2 | 6.85 | 6.2 | 6.2 | 6.15 | 6.2 | 6.25 |
| 19 | 7.25 | 7.8 | 11.5 | 9.25 | 10.4 | 9.05 | 6.75 | 6.2 | 6.2 | 6.15 | 6.2 | 6.3 |
| 20 | 7.3 | 8.6 | 10.0 | 8.9 | 10.25 | 8.95 | 6.85 | 6.25 | 6.15 | 6.15 | 6.2 | 6.4 |
| 21 | 7.7 | 8.45 | 9.35 | 8.8 | 10.35 | 8.95 | 6.75 | 6.25 | 6.15 | 6.15 | 6.25 | 6.4 |
| 22 | 7.5 | 8.2 | 9.25 | 8.75 | 10.05 | 8.9 | 6.7 | 6.25 | 6.1 | 6.15 | 6.3 | 6.3 |
| 23 | 7.7 | 8.1 | 8.85 | 8.9 | 9.9 | 8.7 | 6.75 | 6.25 | 6.15 | 6.15 | 6.3 | 6.25 |
| 24 | 7.65 | 8.1 | 8.8 | 9.05 | 9.85 | 8.45 | 6.85 | 6.25 | 6.15 | 6.15 | 6.25 | 6.2 |
| 25 | 7.55 | 8.15 | 8.85 | 9.45 | 9.95 | 8.2 | 6.75 | 6.25 | 6.15 | 6.1 | 6.2 | 6.2 |
| 26 | 7.5 | 8.3 | 8.9 | 9.65 | 10.0 | 8.25 | 6.7 | 6.25 | 6.15 | 6.1 | 6.2 | 6.25 |
| 27 | 7.35 | 8.3 | 9.2 | 10.0 | 9.55 | 8.1 | 6.65 | 6.25 | 6.15 | 6.1 | 6.3 | 6.3 |
| 28 | 7.3 | 8.25 | 8.75 | 10.1 | 9.2 | 8.0 | 6.55 | 6.25 | 6.15 | 6.1 | 6.3 | 6.3 |
| 29 | 7.25 | ....... | 8.95 | 10.35 | 9.1 | 8.0 | 6.55 | 6.15 | 6.15 | 6.1 | 6.4 | 6.4 |
| 30 | 7.05 | ....... | 8.75 | 10.45 | 9.3 | 8.0 | 6.5 | 6.25 | 6.15 | 6.1 | 6.5 | 6.45 |
| 31 | 6.75 | ....... | 8.65 | ....... | 9.35 | ....... | 6.45 | 6.2 | 6.15 | 6.1 | ....... | 6.4 |

*Station rating table for Stanislaus River at Knights Ferry, Cal., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.00 | 60 | 7.30 | 630 | 8.60 | 1,840 | 9.90 | 3,550 |
| 6.10 | 70 | 7.40 | 710 | 8.70 | 1,960 | 10.00 | 3,700 |
| 6.20 | 80 | 7.50 | 800 | 8.80 | 2,080 | 10.20 | 4,040 |
| 6.30 | 95 | 7.60 | 890 | 8.90 | 2,200 | 10.40 | 4,400 |
| 6.40 | 125 | 7.70 | 980 | 9.00 | 2,320 | 10.60 | 4,800 |
| 6.50 | 160 | 7.80 | 1,070 | 9.10 | 2,440 | 10.80 | 5,230 |
| 6.60 | 200 | 7.90 | 1,160 | 9.20 | 2,560 | 11.00 | 5,730 |
| 6.70 | 245 | 8.00 | 1,250 | 9.30 | 2,680 | 11.20 | 6,330 |
| 6.80 | 295 | 8.10 | 1,340 | 9.40 | 2,800 | 11.40 | 6,990 |
| 6.90 | 350 | 8.20 | 1,440 | 9.50 | 2,950 | 11.60 | 7,700 |
| 7.00 | 410 | 8.30 | 1,540 | 9.60 | 3,100 | | |
| 7.10 | 480 | 8.40 | 1,640 | 9.70 | 3,250 | | |
| 7.20 | 550 | 8.50 | 1,740 | 9.80 | 3,400 | | |

*Estimated monthly discharge of Stanislaus River at Knights Ferry, Cal., for 1905.*

[Drainage area, 935 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,015 | 294 | 642 | 39,480 | 0.687 | 0.792 |
| February | 4,002 | 731 | 1,326 | 73,640 | 1.42 | 1.48 |
| March | 7,394 | 1,533 | 2,395 | 147,300 | 2.56 | 2.95 |
| April | 4,625 | 1,905 | 2,774 | 165,100 | 2.97 | 3.31 |
| May | 6,445 | 2,124 | 3,247 | 99,650 | 3.47 | 4.00 |
| June | 3,296 | 1,351 | 2,392 | 142,300 | 2.56 | 2.86 |
| July | 1,309 | 225 | 613 | 37,690 | .656 | .756 |
| August | 211 | 97 | 150 | 9,223 | .160 | .184 |
| September | 137 | 90 | 103 | 6,129 | .110 | .123 |
| October | 138 | 85 | 97 | 5,964 | .104 | .120 |
| November | 189 | 77 | 91 | 5,415 | .097 | .108 |
| December | 185 | 96 | 131 | 8,055 | .140 | 1.61 |
| The year | 7,394 | 77 | 1,163 | 739,900 | 1.24 | 18.29 |

NOTE.—The discharge of Stanislaus Water Company's ditch and Schell ditch is included above. Mean daily flow of Schell ditch is estimated at 7 second-feet.

## STANISLAUS WATER COMPANY'S DITCH AT KNIGHTS FERRY, CAL.

This station was established June 11, 1904, by S. G. Bennett. The station is located below the point where Schell ditch diverts its water, about 1 mile below the Stanislaus Milling and Power Company's power house and 200 feet below the place where it passes under Schell ditch flume. The water diverted by this ditch is used for irrigation in the vicinity of Oakdale, Cal.

A meter measurement on Schell ditch 200 feet below its intake gave a discharge of about 7 second-feet, which is said to be its usual constant flow. In computing the estimated monthly discharge of Stanislaus River a mean daily discharge of 7 second-feet has been used as the capacity of Schell ditch.

The gage is fastened to the upstream side of a small bridge. During 1905 the gage was read once each day by E. J. Coop.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Stanislaus Water Company's ditch at Knights Ferry, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 14 | F. R. S. Buttemer | 13.2 | 22 | 2.14 | 2.58 | 47 |
| May 23 | R. S. Hawley | 8.7 | 27 | 4.24 | 3.65 | 114 |
| June 16 | do | 8.5 | 24 | 4.00 | 3.45 | 96 |
| July 20 | do | 9 | 21 | 3.67 | 3.00 | 77 |
| September 12 | C. H. Lee | 11 | 6.1 | .85 | 1.12 | 5.2 |
| September 12 | do | 8.7 | 5.5 | 1.58 | 1.50 | 8.7 |
| September 12 | do | 9.4 | 13.1 | 2.52 | 2.18 | 33 |
| September 12 | do | 9.4 | 12.6 | 2.38 | 2.08 | 30 |
| October 17 | R. S. Hawley | 7.5 | 2.1 | .38 | .80 | .8 |

*Daily gage height, in feet, of Stanislaus Water Company's canal at Knights Ferry, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | 2.3 | 2.3 | 3.55 | 3.7 | 3.7 | 3.4 | 3.1 | 1.95 | 2.8 | 0.0 | 2.1 |
| 2 | 2.4 | 2.4 | 2.6 | 3.7 | 3.6 | 3.6 | 3.45 | 3.0 | 2.0 | 2.65 | 1.5 | 2.15 |
| 3 | 2.5 | 2.05 | .0 | 3.5 | 3.5 | 3.6 | 3.35 | 3.05 | 2.1 | 2.4 | 1.8 | 2.2 |
| 4 | 2.5 | 1.9 | .0 | 3.65 | 3.5 | 3.7 | 3.45 | 3.05 | 2.05 | 2.3 | 1.5 | 1.95 |
| 5 | 2.5 | .0 | .0 | 3.55 | 3.55 | 3.6 | 3.35 | 3.1 | 3.45 | 2.2 | 1.5 | 2.2 |
| 6 | 2.3 | 2.1 | 2.3 | 3.65 | 3.6 | 3.6 | 3.4 | 3.1 | 3.3 | 2.1 | 1.2 | 2.1 |
| 7 | 2.5 | .0 | 2.5 | 3.7 | 3.5 | 2.55 | 3.3 | 3.1 | 2.0 | 2.15 | .0 | 2.0 |
| 8 | 2.5 | .0 | 2.25 | 3.65 | 3.3 | 3.45 | 3.4 | 3.05 | 2.0 | 2.2 | .0 | 2.05 |
| 9 | 2.45 | .0 | 2.55 | 3.6 | 3.2 | 3.6 | 3.4 | 3.0 | 2.1 | 2.05 | .0 | 2.1 |
| 10 | 2.45 | .0 | 2.5 | 3.6 | 3.3 | 3.7 | 3.45 | 2.95 | 2.2 | 1.70 | .0 | 2.1 |
| 11 | 2.25 | .0 | 3.4 | 3.55 | 3.4 | 3.65 | 3.3 | 2.95 | 2.15 | 1.75 | .0 | 1.8 |
| 12 | 2.45 | 1.45 | 3.0 | 3.6 | 3.45 | 3.65 | 3.3 | 2.95 | 2.0 | 1.85 | .0 | 1.95 |
| 13 | 2.05 | .0 | 2.6 | 3.5 | 3.4 | 3.6 | 3.3 | 3.1 | 2.1 | 1.4 | .0 | 2.0 |
| 14 | 2.0 | 1.8 | 2.45 | 3.65 | 3.45 | 3.6 | 3.25 | 2.8 | 1.6 | 1.2 | .0 | 1.85 |
| 15 | 2.2 | 1.7 | 2.45 | 3.65 | 3.7 | 3.5 | 3.15 | 2.85 | 1.6 | 1.0 | .0 | 1.65 |
| 16 | 2.15 | 1.9 | 2.6 | 3.7 | 3.7 | 3.5 | 3.35 | 2.9 | 1.5 | 1.4 | .0 | 1.8 |
| 17 | 2.35 | 2.3 | 2.6 | 3.65 | 3.55 | 3.5 | 3.1 | 2.7 | 1.4 | 1.3 | .0 | 2.2 |
| 18 | 2.1 | 2.2 | 2.5 | 3.55 | 3.6 | 3.5 | 3.1 | 2.5 | 1.4 | 1.2 | .0 | 2.1 |
| 19 | 2.1 | 2.4 | 2.45 | 3.6 | 3.7 | 3.5 | 3.0 | 2.45 | 1.1 | 1.3 | .0 | 1.95 |
| 20 | 2.3 | 2.0 | 2.8 | 3.55 | 3.65 | 3.45 | 3.2 | 2.3 | 1.35 | 1.4 | .0 | 2.0 |
| 21 | 2.05 | 2.4 | 2.6 | 3.6 | 3.7 | 3.55 | 3.1 | 2.3 | 1.5 | 1.5 | .0 | 2.0 |
| 22 | 2.2 | 2.3 | 2.8 | 3.6 | 3.65 | 3.45 | 3.0 | 2.05 | 1.6 | 1.55 | .0 | 2.05 |
| 23 | 2.1 | 2.0 | 2.9 | 3.5 | 3.65 | 3.45 | 3.0 | 2.1 | 1.3 | 1.8 | .0 | 1.95 |
| 24 | 2.1 | 2.0 | 3.0 | 3.6 | 3.6 | 3.45 | .0 | 2.0 | 1.7 | 1.4 | .0 | 1.25 |
| 25 | 2.15 | 2.0 | 3.15 | 3.65 | 3.65 | 3.4 | 2.95 | 2.05 | 1.5 | 1.2 | .0 | 1.4 |
| 26 | 2.1 | .0 | 3.2 | 3.7 | 3.65 | 3.35 | 3.0 | 1.9 | 1.65 | 1.3 | .0 | .9 |
| 27 | 2.2 | 2.25 | 3.3 | 3.7 | 3.6 | 3.35 | 3.1 | 1.85 | 1.65 | 1.6 | 1.7 | 2.2 |
| 28 | 2.2 | 2.35 | 3.35 | 3.7 | 3.6 | 3.35 | 3.0 | 1.7 | 1.7 | 1.5 | 1.95 | 2.3 |
| 29 | 2.3 | ....... | 3.4 | 3.7 | 3.6 | 3.4 | 2.95 | 2.15 | 2.2 | 1.45 | 2.0 | 2.2 |
| 30 | 1.65 | ....... | 3.6 | 3.7 | 3.6 | 3.45 | 3.1 | 1.7 | 2.25 | 1.45 | 1.95 | 2.3 |
| 31 | 1.8 | ....... | 3.65 | ....... | 3.65 | ....... | 3.05 | 1.5 | ....... | 1.4 | ....... | 2.2 |

*Station rating table for Stanislaus Water Company's ditch near Knights Ferry, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 2.5 | 1.70 | 14 | 2.40 | 40 | 3.10 | 79 |
| 1.10 | 3.5 | 1.80 | 17 | 2.50 | 45 | 3.20 | 85 |
| 1.20 | 5 | 1.90 | 20 | 2.60 | 50 | 3.30 | 91 |
| 1.30 | 6.5 | 2.00 | 24 | 2.70 | 55 | 3.40 | 97 |
| 1.40 | 8 | 2.10 | 28 | 2.80 | 61 | 3.50 | 104 |
| 1.50 | 10 | 2.20 | 32 | 2.90 | 67 | 3.60 | 111 |
| 1.60 | 12 | 2.30 | 36 | 3.00 | 73 | 3.70 | 118 |

NOTE.—The above table is based on 9 discharge measurements made during 1905. It is well defined between gage heights 1 foot and 3.7 feet. Monthly estimates are included with those of Stanislaus River, page —.

## MISCELLANEOUS MEASUREMENTS IN STANISLAUS RIVER DRAINAGE BASIN.

*Stanislaus River at Parrotts Ferry, Cal.*—A measurement was made on this stream from the downstream side of the wagon bridge at Parrotts Ferry on September 12, 1905, by H. A. Campbell.

Width, 35 feet; area, 138 square feet; mean velocity, 0.66 foot per second; discharge, 91 second-feet.

*South Fork of Stanislaus.*—A measurement was made on this stream on September 25, 1905, at trail crossing to Yancey's ranch about 14 miles above its junction with the main river and about 3 miles north of Confidence, Cal. Measurement made by H. A. Campbell.

Width, 5 feet; area, 2.4 square feet; mean velocity, 0.40 foot per second; discharge, 0.96 second-feet.

*Middle Fork of Stanislaus.*—A measurement was made on this stream on September 26, 1905, at the bridge on the trail to McCormicks, about 5 miles above its junction with the main river. Measurement made by H. A. Campbell.

Width, 21 feet; area, 350 square feet; mean velocity, 0.24 foot per second; discharge, 84 second-feet.

*Griswald Creek.*—This stream enters Stanislaus River about 2 miles above the mouth of the Middle Fork. A measurement was made on September 26, 1905, at trail crossing, about 5 miles above the mouth, by H. A. Campbell.

Width, 6 feet; area, 5.4 square feet; mean velocity, 0.37 foot; discharge, 2.0 second-feet.

*Beaver Creek.*—This stream enters Stanislaus River from the east about 5 miles above the mouth of the Middle Fork. A measurement was made on September 26, 1905, at the trail crossing to the Calaveras big trees and about 5 miles above its junction with North Fork of Stanislaus River. Measurement made by H. A. Campbell.

Width, 2.5 feet; area, 2.8 square feet; mean velocity, 1.64 feet per second; discharge, 4.6 second-feet.

*North Fork of Stanislaus River at Squaw Hollow, Cal.*—A measurement was made about 75 yards upstream from trail bridge at Squaw Hollow on September 27, 1905, by H. A. Campbell.

Width, 29 feet; area, 48 square feet; mean velocity, 1.60 feet per second; discharge, 77 second-feet.

## MOKELUMNE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Mokelumne River drains an area of 657 square miles of the western slope of the Sierra Nevada. It has numerous tributaries, the North, South, and Middle forks being the most important. This stream heads well back in the main crest of the Sierra Nevada at an elevation of 8,000 feet.

The formation is of granite with good soil covering and heavy timber growth on the middle and higher elevations. On the lower elevations the slopes are less rugged and the soil covering is of brush and scattering oak timber with large areas of cultivated land and pasture. There are numerous small glacial lakes and moraines in the upper reaches of this basin. The precipitation varies from 25 inches on the lower to 50 inches on the higher elevations, where it falls in the form of snow, which melts in the early spring. The greatest discharge usually occurs in April, May, and June. There is some artificial storage in this basin, but not enough to have much effect on the discharge.

Several diversions are made for mining and power purposes within the drainage basin, and this water is returned to the river above the gaging station, which is located at Clement, a few miles above Lodi, Cal.

### MOKELUMNE RIVER NEAR CLEMENTS, CAL.

This station was established October 28, 1904, by O. W. Peterson. It is located at the highway bridge, 1 mile north of Clements.

The channel is straight for 150 feet above and 500 feet below the gaging station. The right bank is high and not subject to overflow. The left bank is subject to overflow when the gage reads above 15 feet. The bed of the stream is composed of gravel and is subject to slight changes.

Discharge measurements are made from the downstream side of the bridge. The initial point is on the end of the bridge near the right bank.

The gage is in two sections. The low-water section is an inclined rod nailed to posts driven in the ground, and the high-water section is a vertical rod nailed to a pile and near the inclined rod. Both are on the right bank. During 1905 the gage was read by Allen Gaskill. The bench mark is the head of a bolt driven in a pile, to which the upper section of the gage is fastened; elevation, 9.60 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Mokelumne River near Clements, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 23 | F. R. S. Buttemer | 132 | 293 | 2.69 | 5.15 | 788 |
| January 24 | do | 128 | 258 | 2.40 | 4.85 | 620 |
| January 24 | do | 128 | 250 | 2.38 | 4.79 | 596 |
| January 30 | do | 121 | 191 | 2.01 | 4.28 | 384 |
| February 9 | do | 126 | 259 | 2.39 | 4.87 | 620 |
| February 15 | do | 122 | 193 | 2.27 | 4.31 | 438 |
| February 20 | do | 210 | 562 | 2.54 | 6.14 | 1,425 |
| May 18 | W. B. Clapp | 248 | 1,238 | 3.06 | 9.00 | 3,788 |
| June 29 | O. W. Peterson | 130 | 237 | 2.36 | 4.64 | 559 |
| July 28 | Peterson and Lee | 60 | 80 | 1.56 | 3.14 | 125 |
| September 5 | C. H. Lee | 58 | 79 | 1.27 | 3.13 | 100 |
| November 29 | do | 55 | 66 | .86 | 2.90 | 57 |

*Daily gage height, in feet, of Mokelumne River near Clements, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 4.85 | 5.4 | 6.05 | 7.5 | 7.65 | 4.3 | 3.2 | 3.3 | 3.4 | 3.25 | 3.25 |
| 2 | 4.55 | 7.55 | 5.45 | 6.2 | 7.0 | 7.45 | 4.3 | 3.3 | 3.3 | 3.25 | 3.2 | 3.1 |
| 3 | 4.5 | 5.8 | 5.5 | 6.3 | 6.9 | 7.15 | 4.1 | 3.3 | 3.25 | 3.3 | 3.25 | 3.1 |
| 4 | 4.4 | 5.35 | 5.65 | 6.45 | 6.65 | 6.9 | 4.0 | 3.3 | 3.3 | 3.25 | 3.1 | 3.0 |
| 5 | 4.15 | 6.55 | 5.6 | 6.7 | 6.5 | 6.6 | 3.85 | 3.2 | 3.3 | 3.3 | 3.1 | 2.95 |
| 6 | 4.3 | 5.7 | 5.7 | 6.8 | 6.4 | 6.8 | 3.85 | 3.25 | 3.3 | 3.3 | 3.1 | 2.95 |
| 7 | 4.1 | 5.3 | 5.5 | 6.95 | 6.6 | 7.1 | 3.8 | 3.15 | 3.3 | 3.45 | 3.1 | 3.1 |
| 8 | 4.1 | 5.0 | 5.6 | 7.05 | 6.9 | 7.05 | 4.05 | 3.3 | 3.35 | 3.4 | 2.95 | 3.1 |
| 9 | 4.3 | 4.9 | 5.45 | 6.85 | 6.55 | 7.0 | 3.65 | 3.25 | 3.3 | 3.25 | 3.0 | 3.05 |
| 10 | 4.3 | 4.65 | 5.45 | 7.0 | 6.4 | 7.15 | 3.6 | 3.3 | 3.3 | 3.35 | 2.95 | 3.05 |
| 11 | 4.1 | 4.65 | 5.5 | 6.6 | 6.3 | 7.55 | 3.7 | 3.2 | 3.2 | 3.3 | 2.95 | 3.0 |
| 12 | 4.1 | 4.55 | 5.45 | 6.25 | 6.3 | 7.75 | 3.6 | 3.3 | 3.3 | 3.35 | 2.95 | 3.1 |
| 13 | 4.15 | 4.5 | 6.1 | 6.25 | 6.25 | 7.75 | 3.65 | 3.2 | 3.3 | 3.35 | 2.9 | 3.05 |
| 14 | 4.15 | 4.55 | 6.15 | 6.45 | 6.2 | 7.1 | 3.45 | 2.9 | 3.35 | 3.15 | 2.95 | 3.1 |
| 15 | 4.2 | 4.35 | 5.55 | 6.6 | 7.4 | 6.95 | 3.45 | 3.35 | 3.35 | 3.15 | 2.85 | 3.05 |
| 16 | 4.7 | 4.4 | 5.6 | 6.75 | 8.25 | 6.85 | 3.35 | 3.3 | 3.3 | 3.25 | 2.85 | 3.05 |
| 17 | 4.3 | 4.95 | 6.2 | 6.35 | 10.55 | 6.65 | 3.3 | 3.3 | 3.3 | 3.25 | 2.8 | 3.1 |
| 18 | 4.25 | 4.9 | 6.55 | 6.9 | 9.0 | 6.5 | 3.3 | 3.35 | 3.35 | 3.05 | 2.8 | 3.15 |
| 19 | 4.35 | 4.85 | 7.05 | 6.8 | 8.85 | 6.25 | 3.3 | 3.4 | 3.35 | 3.2 | 2.85 | 3.15 |
| 20 | 4.4 | 5.8 | 7.3 | 6.35 | 8.8 | 6.15 | 3.3 | 3.25 | 3.35 | 3.1 | 2.9 | 3.2 |
| 21 | 4.45 | 5.5 | 6.85 | 6.05 | 8.85 | 6.0 | 3.3 | 3.25 | 3.35 | 3.05 | 3.05 | 3.3 |
| 22 | 4.45 | 5.25 | 6.65 | 6.05 | 8.25 | 5.75 | 3.3 | 3.25 | 3.4 | 3.0 | 2.85 | 3.35 |
| 23 | 5.0 | 5.15 | 6.3 | 6.25 | 7.9 | 5.45 | 3.3 | 3.25 | 3.35 | 2.9 | 2.9 | 3.3 |
| 24 | 4.85 | 5.1 | 6.55 | 6.7 | 8.65 | 5.35 | 3.3 | 3.25 | 3.4 | 2.95 | 2.95 | 3.2 |
| 25 | 4.6 | 5.25 | 6.5 | 7.25 | 8.6 | 4.9 | 3.3 | 3.3 | 3.3 | 3.1 | 2.85 | 3.0 |
| 26 | 4.55 | 5.45 | 6.3 | 7.6 | 8.95 | 5.1 | 3.25 | 3.35 | 3.35 | 3.0 | 2.85 | 2.95 |
| 27 | 4.45 | 5.55 | 6.9 | 8.3 | 7.35 | 4.9 | 3.2 | 3.35 | 3.35 | 3.2 | 3.2 | 3.05 |
| 28 | 4.2 | 5.35 | 6.45 | 8.3 | 7.1 | 4.75 | 3.2 | 3.3 | 3.35 | 3.15 | 3.25 | 3.1 |
| 29 | 4.25 | ....... | 6.85 | 8.4 | 7.45 | 4.65 | 3.15 | 3.25 | 3.35 | 3.0 | 3.3 | 3.1 |
| 30 | 4.3 | ....... | 6.4 | 8.15 | 7.45 | 4.4 | 3.15 | 3.3 | 3.45 | 3.05 | 3.15 | 3.1 |
| 31 | 4.35 | ....... | 6.2 | ....... | 7.6 | ....... | 3.2 | 3.35 | ....... | 3.15 | ....... | 3.15 |

*Station rating table for Mokelumne River near Clements, Cal., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.00 | 78 | 4.30 | 391 | 5.60 | 1,059 | 6.90 | 2,000 |
| 3.10 | 96 | 4.40 | 427 | 5.70 | 1,124 | 7.00 | 2,080 |
| 3.20 | 115 | 4.50 | 465 | 5.80 | 1,191 | 7.20 | 2,240 |
| 3.30 | 134 | 4.60 | 506 | 5.90 | 1,260 | 7.40 | 2,400 |
| 3.40 | 154 | 4.70 | 550 | 6.00 | 1,330 | 7.60 | 2,560 |
| 3.50 | 174 | 4.80 | 597 | 6.10 | 1,400 | 7.80 | 2,730 |
| 3.60 | 195 | 4.90 | 647 | 6.20 | 1,475 | 8.00 | 2,900 |
| 3.70 | 218 | 5.00 | 700 | 6.30 | 1,550 | 8.20 | 3,070 |
| 3.80 | 242 | 5.10 | 755 | 6.40 | 1,625 | 8.40 | 3,250 |
| 3.90 | 268 | 5.20 | 812 | 6.50 | 1,700 | 8.60 | 3,430 |
| 4.00 | 295 | 5.30 | 871 | 6.60 | 1,775 | 8.80 | 3,610 |
| 4.10 | 325 | 5.40 | 932 | 6.70 | 1,850 | 9.00 | 3,800 |
| 4.20 | 357 | 5.50 | 995 | 6.80 | 1,925 | | |

NOTE.—The above table is based on 12 discharge measurements made during 1905. It is well defined between gage heights 2.9 feet and 6.2 feet. The table has been extended beyond these limits, being based on 1 measurement at 9 feet gage height.

*Estimated monthly discharge of Mokelumne River near Clements, Calif., for 1905.*

[Drainage area, 642 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Sec.-feet per sq. mile. | Depth in inches. |
| January | 700 | 325 | 428 | 26,320 | .667 | .769 |
| February | 2,520 | 409 | 853 | 47,370 | 1.33 | 1.38 |
| March | 2,320 | 932 | 1,410 | 86,700 | 2.20 | 2.54 |
| April | 3,250 | 1,365 | 1,959 | 116,600 | 3.05 | 3.40 |
| May | 5,260 | 1,475 | 2,547 | 156,600 | 3.97 | 4.58 |
| June | 2,688 | 427 | 1,665 | 99,070 | 2.59 | 2.89 |
| July | 391 | 106 | 188 | 11,560 | .293 | .338 |
| August | 154 | 60 | 128 | 7,870 | .199 | .229 |
| September | 164 | 115 | 139 | 8,271 | .217 | .242 |
| October | 164 | 60 | 114 | 7,010 | .178 | .205 |
| November | 134 | 43 | 794 | 4,725 | .124 | .138 |
| December | 144 | 69 | 970 | 5,964 | .151 | .174 |
| The year | 5,260 | 43 | 801 | 578,100 | 1.25 | 16.88 |

## NORTHERN PACIFIC OCEAN DRAINAGE BASIN.

### RUSSIAN RIVER DRAINAGE BASIN.

#### MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous discharge measurements made in Russian River drainage basin during 1905:

*Russian River at Calpella, Cal.*—A measurement of this stream was made on September 21, 1905, one-fourth mile east of Calpella and about 3 miles above mouth of East Fork of Russian River by R. S. Hawley.

Width, 6 feet; area, 1.6 square feet; mean velocity, 0.75 foot per second; discharge, 1.2 second-feet.

*East Fork of Russian River near Ukiah, Cal.*—A measurement of this stream was made September 21, 1905, one-fourth mile above its junction with Russian River by R. S. Hawley.

Width, 10 feet; area, 4.6 square feet; mean velocity, 0.48 foot per second; discharge, 2.2 second-feet.

*Russian River at Preston, Cal.*—A measurement of this stream was made September 22, 1905, 1 mile above Preston, Cal., by R. S. Hawley.

Width, 23 feet; area, 9.8 square feet; mean velocity, 1.05 feet per second; discharge, 10.3 second-feet.

### EEL RIVER DRAINAGE BASIN.

#### MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous discharge measurements made in Eel River drainage basin during 1905:

*South Eel River at Hearst, Cal.*—This stream is tributary to the Eel River from the south. A measurement was made 600 feet below the Hearst bridge on September 19, 1905, by R. S. Hawley.

Width, 20 feet; area, 7.6 square feet; mean velocity, 1.25 feet per second; discharge, 9.5 second-feet.

*Middle Eel River at Covelo, Cal.*—A measurement of this stream was made September 19, 1905, at the road crossing between Willets and Covelo about 7 miles above its junction with South Eel by R. S. Hawley.

Width, 34 feet; area, 12.2 square feet; mean velocity, 0.57 foot per second; discharge, 7.0 second-feet.

*Middle Eel River at Laytonville, Cal.*—A measurement of this stream was made September 20, 1905, 50 feet above its junction with South Eel River by R. S. Hawley.

Width, 18 feet; area, 22 square feet; mean velocity, 0.36 foot per second; discharge, 8.0 second-feet.

*Eel River at Laytonville, Cal.*—A measurement of this stream was made September 20, 1905, 50 feet below the junction of Middle and South Eel rivers by R. S. Hawley.

Width, 20 feet; area, 16 square feet; mean velocity, 1.69 feet per second; discharge, 27 second-feet.

*South Eel River at Laytonville, Cal.*—From the difference of the measurement made below the junction of the Middle and South Eel and that made on Middle Eel above on September 20, 1905, the discharge of South Eel at the junction is 19.2 second-feet.

## KLAMATH RIVER DRAINAGE BASIN.

### LINK RIVER AT KLAMATH FALLS, OREG.[a]

This station was established May 15, 1904, by J. H. Lewis. It is located at the county bridge at Klamath Falls, Oreg., 1½ miles below the outlet of Klamath Lake.

The channel is straight for 400 feet above and below the station. The current is swift; the fall in the 1½ miles between the lake and the gaging station is about 70 feet. The right bank is low and wooded, but not liable to overflow. The left bank is high and rocky. The bed of the stream is composed of gravel, free from vegetation, and subject to some change. There is but one channel at all stages. One irrigation ditch takes water from the river on the left bank about three-fourths mile above the station. Driftwood from a sawmill above the station collects around the bridge piers and interferes materially with the accuracy of measurements. A short distance below the gaging station the river discharges into a lake of considerable size. At flood stages the velocity is checked by water backing up from the lake below, which has a tendency to give decreased velocities with high gage readings. Gage heights may be affected by wind piling up the water of the upper and lower lakes.

Discharge measurements are made from the upstream side of the bridge. The initial point for soundings is the first vertical rod supporting the floor beam at the left end of the bridge, upstream side.

A staff gage is fastened vertically to the plank bracing between steel caissons near the left bank. During 1905 the gage was read once each day by G. H. Woodbury. Bench marks were established as follows: (1) A 30-penny nail driven into the floor beam over the gage; elevation, 12.50 feet. (2) The center of a cross cut in the first sandstone above the ground in the southwest corner of the foundation of the Linkville Hotel; elevation, 15.88 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

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[a] This station was known as Klamath River at Klamath Falls, Oreg., in report for 1904.

*Discharge measurements of Link River at Klamath Falls, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 4 | C. T. Darley | 282 | 1,571 | 1.82 | 4.05 | 2,862 |
| January 17 | do | 282 | 1,570 | 1.76 | 4.10 | 2,768 |
| January 17 | do | 282 | 1,571 | 1.83 | 4.10 | 2,872 |
| January 17 | do | 282 | 1,571 | 1.67 | 4.10 | 2,627 |
| February 1 | do | 287 | 1,660 | 2.01 | 4.30 | 3,338 |
| February 13 | do | 288 | 1,683 | 1.78 | 4.50 | 2,994 |
| February 17 | do | 288 | 1,648 | 1.70 | 4.40 | 2,802 |
| March 2 | do | 288 | 1,642 | 1.82 | 4.40 | 2,984 |
| April 12 | do | 290 | 1,733 | 2.10 | 4.49 | 3,645 |
| June 5 | do | 279 | 1,494 | 1.56 | 3.88 | 2,324 |
| June 20 | do | 277 | 1,410 | 1.28 | 3.59 | 1,800 |
| June 28 | do | 283 | 1,354 | 1.12 | 3.40 | 1,517 |
| July 11 | do | 297 | 1,280 | 1.15 | 3.14 | 1,466 |
| July 18 | do | 272 | 1,234 | .86 | 2.97 | 1,063 |
| July 28 | do | 270 | 1,178 | .89 | 2.80 | 1,049 |
| August 7 | do | 267 | 1,162 | .90 | 2.63 | 1,041 |
| August 14 | do | 267 | 1,146 | .93 | 2.59 | 1,066 |
| August 16 | W. B. Clapp and C. T. Darley | 267 | 1,187 | .93 | 2.60 | 1,104 |
| September 7 | C. T. Darley | 267 | 1,141 | .90 | 2.58 | 1,032 |
| September 16 | do | 268 | 1,155 | .93 | 2.58 | 1,073 |
| November 2 | do | 272 | 1,254 | 1.02 | 2.90 | 1,283 |

*Daily gage height, in feet, of Link River at Klamath Falls, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.1 | 4.2 | 4.4 | 4.5 | 4.2 | 3.95 | 3.45 | 2.79 | 2.6 | 2.7 | 2.81 | 3.25 |
| 2 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.85 | 3.45 | 2.75 | 2.6 | 2.65 | 2.8 | 3.3 |
| 3 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.85 | 3.3 | 2.7 | 2.58 | 2.7 | 2.81 | 3.29 |
| 4 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.9 | [a]3.3 | 2.67 | 2.6 | 2.7 | 2.84 | 3.2 |
| 5 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.88 | 3.25 | 2.67 | 2.58 | 2.9 | 2.82 | 3.2 |
| 6 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.88 | 3.3 | 2.67 | 2.6 | 2.9 | 2.88 | 3.2 |
| 7 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.81 | 3.2 | 2.5 | 2.58 | 2.95 | 2.86 | 3.21 |
| 8 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.88 | 3.2 | 2.63 | 2.58 | 2.7 | 2.99 | 3.23 |
| 9 | 4.1 | 4.4 | 4.4 | 4.5 | 4.2 | 3.85 | [a]3.25 | 2.6 | 2.58 | 2.9 | 2.99 | 3.24 |
| 10 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.8 | 3.25 | 2.6 | 2.62 | 2.8 | 2.98 | 3.28 |
| 11 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.8 | [a]3.25 | 2.59 | 2.63 | 2.75 | 2.99 | 3.25 |
| 12 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.78 | [a]3.2 | 2.6 | 2.58 | 2.8 | 2.9 | 3.26 |
| 13 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.75 | 3.2 | 2.6 | 2.58 | 2.8 | 2.95 | 3.27 |
| 14 | 4.1 | 4.5 | 4.4 | 4.5 | 4.2 | 3.7 | 3.1 | 2.59 | 2.6 | 2.8 | 2.95 | 3.24 |
| 15 | 4.1 | 4.5 | 4.4 | 4.5 | 4.1 | 3.6 | 3.05 | 2.6 | 2.6 | 2.7 | 2.95 | 3.34 |
| 16 | 4.1 | 4.5 | 4.4 | 4.5 | 4.1 | 3.7 | [a]3.0 | 2.6 | 2.55 | 2.8 | 2.9 | 3.26 |
| 17 | 4.1 | 4.4 | 4.4 | 4.5 | 4.1 | 3.62 | 2.9 | 2.60 | 2.5 | 2.8 | 2.9 | 3.33 |
| 18 | 4.1 | 4.4 | 4.4 | 4.45 | 4.05 | [a]3.61 | 2.9 | 2.63 | 2.55 | 2.8 | 2.9 | 3.32 |
| 19 | 4.1 | 4.4 | 4.4 | 4.4 | 4.05 | 3.6 | 3.0 | 2.6 | 2.6 | 2.8 | 3.2 | 3.32 |
| 20 | 4.1 | 4.4 | 4.4 | 4.4 | 4.05 | 3.59 | 2.9 | 2.6 | 2.6 | 2.85 | 3.1 | 3.26 |
| 21 | 4.1 | 4.4 | 4.4 | 4.35 | 4.0 | [a]3.55 | 2.9 | 2.6 | 2.6 | 2.85 | 3.3 | 3.27 |
| 22 | 4.1 | 4.4 | 4.4 | 4.35 | 4.0 | 3.5 | 2.95 | 2.6 | 2.58 | 2.79 | 3.2 | 3.33 |
| 23 | 4.1 | 4.4 | 4.4 | 4.35 | 4.0 | 3.5 | 2.85 | 2.6 | 2.6 | 2.8 | 3.15 | 3.3 |
| 24 | 4.2 | 4.4 | 4.4 | 4.3 | 4.0 | 3.5 | 2.85 | 2.6 | 2.68 | 2.85 | 3.1 | 3.32 |
| 25 | 4.2 | 4.4 | 4.4 | 4.3 | 4.0 | 3.4 | [a]2.85 | 2.6 | 2.55 | 2.81 | 3.2 | 3.29 |
| 26 | 4.2 | 4.4 | 4.4 | 4.3 | 4.0 | 3.4 | [a]2.85 | 2.7 | 2.58 | 2.8 | 3.25 | 3.35 |
| 27 | 4.2 | 4.4 | 4.4 | 4.3 | 4.0 | 3.4 | [a]2.8 | 2.8 | 2.6 | 2.89 | 3.15 | 3.36 |
| 28 | 4.1 | 4.4 | 4.5 | 4.25 | 4.0 | 3.4 | [a]2.8 | 2.6 | 2.62 | 2.88 | 3.15 | 3.33 |
| 29 | 4.2 | ....... | 4.6 | 4.25 | 4.0 | 3.4 | 2.78 | 2.6 | 2.65 | 2.88 | 3.4 | 3.4 |
| 30 | 4.2 | ....... | 4.5 | 4.25 | 3.95 | 3.35 | 2.79 | 2.65 | 2.65 | 2.81 | 3.2 | 3.53 |
| 31 | 4.2 | ....... | 4.5 | ....... | 3.95 | ....... | 2.78 | 2.55 | ....... | 2.9 | ....... | 3.53 |

[a] Estimated.

*Station rating table for Link River at Klamath Falls, Oreg., from May 15, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.50 | 985 | 3.60 | 1,920 | 4.70 | 3,580 | 5.80 | 5,790 |
| 2.60 | 1,035 | 3.70 | 2,045 | 4.80 | 3,770 | 5.90 | 6,020 |
| 2.70 | 1,090 | 3.80 | 2,175 | 4.90 | 3,960 | 6.00 | 6,250 |
| 2.80 | 1,150 | 3.90 | 2,310 | 5.00 | 4,150 | 6.20 | 6,710 |
| 2.90 | 1,220 | 4.00 | 2,450 | 5.10 | 4,340 | 6.40 | 7,180 |
| 3.00 | 1,300 | 4.10 | 2,590 | 5.20 | 4,530 | 6.60 | 7,660 |
| 3.10 | 1,390 | 4.20 | 2,740 | 5.30 | 4,730 | 6.80 | 8,140 |
| 3.20 | 1,485 | 4.30 | 2,900 | 5.40 | 4,930 | 7.00 | 8,640 |
| 3.30 | 1,585 | 4.40 | 3,060 | 5.50 | 5,140 | 7.20 | 9,140 |
| 3.40 | 1,690 | 4.50 | 3,230 | 5.60 | 5,350 | | |
| 3.50 | 1,800 | 4.60 | 3,400 | 5.70 | 5,570 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on twenty-eight discharge measurements made during 1904-5. It is not very well defined.

*Estimated monthly discharge of Link River at Klamath Falls, Oreg., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean | |
| 1904. | | | | |
| May 15-31 | 9,015 | 8,140 | 8,640 | 291,300 |
| June | 8,140 | 5,245 | 6,740 | 401,100 |
| July | 5,140 | 3,060 | 4,123 | 253,500 |
| August | 2,980 | 1,860 | 2,336 | 143,600 |
| September | 1,800 | 1,535 | 1,662 | 98,900 |
| October | 1,745 | 1,585 | 1,686 | 103,700 |
| November | 1,982 | 1,745 | 1,837 | 109,300 |
| December | 2,520 | 1,860 | 2,185 | 134,400 |
| The period | | | | 1,536,000 |
| 1905. | | | | |
| January | 2,740 | 2,590 | 2,624 | 161,300 |
| February | 3,230 | 2,740 | 3,103 | 172,300 |
| March | 3,400 | 3,060 | 3,087 | 189,800 |
| April | 3,230 | 2,820 | 3,106 | 184,800 |
| May | 2,740 | 2,380 | 2,597 | 159,700 |
| June | 2,380 | 1,638 | 2,004 | 119,200 |
| July | 1,745 | 1,138 | 1,363 | 83,810 |
| August | 1,144 | 985 | 1,051 | 64,620 |
| September | 1,062 | 985 | 1,033 | 61,290 |
| October | 1,260 | 1,062 | 1,159 | 71,260 |
| November | 1,690 | 1,150 | 1,330 | 79,140 |
| December | 1,860 | 1,485 | 1,587 | 100,800 |
| The year | 3,400 | 985 | 2,004 | 1,448,000 |

## KLAMATH RIVER AT KENO, OREG.

This station was established August 13, 1904, by T. H. Humphreys. It is located one-fourth mile below the county bridge at Keno, Oreg.

The channel is straight for one-fourth mile above and below the station. The current is sluggish at low and moderate at high stages. Both banks are low, clean, and liable to overflow. The bed of the stream is composed of bowlders. An up or down stream wind piles up the water near the gage on account of the low velocities.

Discharge measurements are made by means of a cable and car one-fourth mile downstream from the bridge. The initial point for soundings is at the cable support on the right bank.

A staff gage is fastened vertically to the downstream side of the second bent from the left end of the bridge. During 1905 the gage was read once each day by S. Padgett. Bench marks were established as follows: (1) The top of projecting cap of bridge bent to which the gage is nailed; elevation, 16.80 feet. (2) A 60-penny nail driven into the south gatepost on the west side of the road 58 feet from the south end of the bridge; elevation, 18.85 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Klamath River at Keno, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 10 | C. T. Darley | 407 | 3,800 | 0.68 | 13.00 | 2,590 |
| January 23 | do | 420 | 3,794 | .77 | 13.30 | 2,930 |
| January 30 | do | 420 | 3,804 | .76 | 13.20 | 2,875 |
| February 9 | do | 425 | 3,700 | .80 | 13.25 | 2,975 |
| February 18 | do | 428 | 3,838 | .83 | 13.30 | 3,192 |
| March 3 | do | 432 | 3,850 | .82 | 13.30 | 3,145 |
| March 31 | do | 425 | 3,828 | .83 | 13.32 | 3,159 |
| April 13 | do | 425 | 3,760 | .80 | 13.28 | 3,015 |
| May 17 | do | 427 | 3,687 | .73 | 13.03 | 2,676 |
| June 19 | do | 410 | 3,545 | .59 | 12.68 | 2,102 |
| July 14 | do | 407 | 3,348 | .43 | 12.20 | 1,445 |
| August 14 | do | 402 | 3,129 | .37 | 11.80 | 1,146 |
| August 31 | do | 404 | 3,221 | .29 | 11.75 | 924 |
| November 3 | do | 409 | 3,325 | .20 | 12.00 | 680 |
| December 3 | do | 410 | 3,390 | .25 | 12.28 | 851 |

*Daily gage height, in feet, of Klamath River at Keno, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.9 | 13.2 | 13.3 | 13.4 | 13.2 | 13.0 | 12.5 | 11.9 | 11.8 | 11.9 | 12.1 | 12.3 |
| 2 | 12.9 | 13.2 | 13.3 | 13.4 | 13.2 | 13.0 | 12.4 | 11.9 | 11.8 | 11.9 | 12.1 | 12.3 |
| 3 | 13.0 | 13.3 | 13.3 | 13.4 | 13.2 | 13.0 | 12.4 | 11.9 | 11.8 | 11.9 | 12.1 | 12.3 |
| 4 | 13.0 | 13.3 | 13.3 | 13.4 | 13.2 | 13.0 | 12.4 | 11.9 | 11.8 | 11.9 | 12.1 | 12.3 |
| 5 | 13.0 | 13.3 | 13.3 | 13.4 | 13.2 | 13.0 | 12.4 | 11.9 | 11.8 | 11.9 | 12.1 | 12.3 |
| 6 | 13.0 | 13.3 | 13.3 | 13.4 | 13.2 | 12.9 | 12.3 | 11.8 | 11.8 | 11.9 | 12.1 | 12.3 |
| 7 | 13.0 | 13.3 | 13.3 | 13.4 | 13.2 | 12.9 | 12.3 | 11.8 | 11.8 | 11.9 | 12.1 | 12.3 |
| 8 | 13.1 | 13.3 | 13.3 | 13.4 | 13.1 | 12.9 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 9 | 13.1 | 13.3 | 13.3 | 13.4 | 13.1 | 12.9 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 10 | 13.1 | 13.3 | 13.3 | 13.4 | 13.1 | 12.9 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 11 | 13.1 | 13.3 | 13.3 | 13.4 | 13.1 | 12.9 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 12 | 13.1 | 13.3 | 13.3 | 13.3 | 13.1 | 12.8 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 13 | 13.1 | 13.3 | 13.2 | 13.3 | 13.1 | 12.8 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 14 | 13.1 | 13.3 | 13.2 | 13.3 | 13.1 | 12.8 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 15 | 13.1 | 13.3 | 13.2 | 13.3 | 13.1 | 12.7 | 12.2 | 11.8 | 11.8 | 11.9 | 12.1 | 12.4 |
| 16 | 13.1 | 13.3 | 13.2 | 13.3 | 13.1 | 12.7 | 12.2 | 11.8 | 11.8 | 11.9 | 12.2 | 12.4 |
| 17 | 13.1 | 13.3 | 13.2 | 13.3 | 13.0 | 12.7 | 12.2 | 11.8 | 11.8 | 12.0 | 12.2 | 12.4 |
| 18 | 13.1 | 13.3 | 13.2 | 13.3 | 13.0 | 12.7 | 12.2 | 11.8 | 11.8 | 12.0 | 12.2 | 12.4 |
| 19 | 13.1 | 13.3 | 13.2 | 13.2 | 13.0 | 12.6 | 12.1 | 11.8 | 11.8 | 12.0 | 12.2 | 12.4 |
| 20 | 13.1 | 13.3 | 13.2 | 13.2 | 13.0 | 12.6 | 12.1 | 11.8 | 11.8 | 12.0 | 12.2 | 12.4 |
| 21 | 13.1 | 13.3 | 13.2 | 13.2 | 13.0 | 12.6 | 12.1 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 22 | 13.1 | 13.3 | 13.2 | 13.2 | 13.0 | 12.5 | 12.1 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 23 | 13.3 | 13.3 | 13.2 | 13.2 | 13.0 | 12.5 | 12.1 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 24 | 13.1 | 13.3 | 13.2 | 13.2 | 13.0 | 12.5 | 12.1 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 25 | 13.1 | 13.3 | 13.3 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 26 | 13.1 | 13.3 | 13.3 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.8 | 12.0 | 12.3 | 12.4 |
| 27 | 13.1 | 13.3 | 13.3 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.8 | 12.0 | 12.3 | 12.5 |
| 28 | 13.2 | 13.3 | 13.4 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.8 | 12.1 | 12.3 | 12.5 |
| 29 | 13.2 | ....... | 13.4 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.9 | 12.1 | 12.3 | 12.5 |
| 30 | 13.2 | ....... | 13.4 | 13.2 | 13.0 | 12.5 | 12.0 | 11.8 | 11.9 | 12.1 | 12.3 | 12.5 |
| 31 | 13.2 | ....... | 13.4 | ....... | 13.0 | ....... | 11.9 | 11.8 | ....... | 12.1 | ....... | 12.5 |

*Station rating table for Klamath River at Keno, Oreg., from May 31, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 11.60 | 900 | 12.60 | 1,960 | 13.60 | 3,730 | 14.60 | 6,590 |
| 11.70 | 970 | 12.70 | 2,100 | 13.70 | 3,960 | 14.70 | 6,940 |
| 11.80 | 1,050 | 12.80 | 2,250 | 13.80 | 4,200 | 14.80 | 7,300 |
| 11.90 | 1,140 | 12.90 | 2,400 | 13.90 | 4,460 | 14.90 | 7,670 |
| 12.00 | 1,240 | 13.00 | 2,560 | 14.00 | 4,730 | 15.00 | 8,050 |
| 12.10 | 1,350 | 13.10 | 2,730 | 14.10 | 5,010 | 15.10 | 8,440 |
| 12.20 | 1,460 | 13.20 | 2,910 | 14.20 | 5,300 | 15.20 | 8,840 |
| 12.30 | 1,580 | 13.30 | 3,100 | 14.30 | 5,600 | 15.30 | 9,250 |
| 12.40 | 1,700 | 13.40 | 3,300 | 14.40 | 5,920 | | |
| 12.50 | 1,830 | 13.50 | 3,510 | 14.50 | 6,250 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 22 discharge measurements made during 1904-5. It is well defined between gage heights 12.2 feet and 13.3 feet.

*Estimated monthly discharge of Klamath River at Keno, Oreg., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| June | 8,440 | 5,300 | 7,076 | 421,100 |
| July | 5,300 | 3,300 | 4,177 | 256,800 |
| August | 3,100 | 2,100 | 2,513 | 154,500 |
| September | 2,100 | 1,700 | 1,778 | 105,800 |
| October | 1,830 | 1,700 | 1,775 | 109,100 |
| November | 2,100 | 1,960 | 2,007 | 119,400 |
| December | 2,400 | 2,100 | 2,235 | 137,400 |
| The period | | | | 1,304,000 |
| 1905. | | | | |
| January | 3,100 | 2,400 | 2,716 | 167,000 |
| February | 3,100 | 2,910 | 3,086 | 171,400 |
| March | 3,300 | 2,910 | 3,052 | 187,700 |
| April | 3,300 | 2,910 | 3,097 | 184,300 |
| May | 2,910 | 2,560 | 2,688 | 165,300 |
| June | 2,560 | 1,830 | 2,157 | 128,400 |
| July | 1,830 | 1,140 | 1,436 | 88,300 |
| August | 1,140 | 1,050 | 1,065 | 65,480 |
| September | 1,140 | 1,050 | 1,056 | 62,840 |
| October | 1,350 | 1,140 | 1,203 | 73,970 |
| November | 1,580 | 1,350 | 1,445 | 85,980 |
| December | 1,830 | 1,580 | 1,694 | 104,200 |
| The year | 3,300 | 1,050 | 2,058 | 1,485,000 |

### SYCAN RIVER NEAR SILVERLAKE, OREG.

This station was established May 2, 1905, by Ivan Landes. It is located about 30 miles south of Silverlake, Oreg., in sec. 19, T. 32 S., R. 14 E.

The channel is straight for about 20 feet above and 150 feet below the station. The current is swift. The right bank is high, rocky, and clean and does not overflow. The left bank is low, clean, and subject to overflow at extreme high stages. The bed of the stream is of rocks, gravel, and sand, free from vegetation, and permanent. There is but one channel at low and two channels at high stages.

Discharge measurements are made from a private bridge. The initial point for soundings is at the west end of the bridge.

A staff gage is fastened vertically to a bent of the bridge. During 1905 the gage was read by O. F. Griffith and J. S. Wakefield. The bench mark is a marked point of rock on the right bank a short distance upstream from the bridge; elevation, 6.79 feet above the datum of the gage.

*Discharge measurements of Sycan River near Silverlake, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| March 16 | Ivan Landes | 21 | 28 | 1.38 | 2.40 | 38 |
| April 10 | do | 30 | 46 | 2.36 | 3.05 | 110 |
| May 2 | do | 56 | 93 | 1.76 | 3.45 | 163 |
| June 12 | do | 52 | 44 | 1.56 | 2.32 | 69 |
| July 30 | Landes and King | 19 | 11.9 | .86 | 1.27 | 10.2 |
| October 3 | Ivan Landes | 14 | 14.9 | .36 | 1.70 | 5.4 |
| November 7 | do | 12 | 7.1 | .85 | 1.12 | 6.0 |

*Daily gage height, in feet, of Sycan River, near Silverlake, Oreg., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.6 | 1.8 | 1.25 | 1.4 | ...... | 17 | 3.5 | 2.15 | 1.45 | 1.0 | 1.75 | 1.8 |
| 2 | 3.45 | 2.6 | 1.8 | 1.25 | 1.4 | 1.7 | 18 | 3.4 | 2.05 | 1.45 | 1.05 | 1.8 | 1.8 |
| 3 | 3.35 | 2.6 | 1.75 | 1.1 | 1.5 | 1.85 | 19 | 3.3 | 2.2 | [a]1.3 | 1.05 | 1.8 | 1.7 |
| 4 | 3.25 | 3.0 | 1.75 | 1.15 | 1.5 | 1.7 | 20 | 3.4 | 2.1 | 1.35 | 1.1 | 1.75 | 1.85 |
| 5 | 3.2 | 3.1 | 1.7 | .8 | 1.55 | 1.85 | 21 | 2.9 | 2.0 | 1.4 | 1.1 | 1.75 | 1.7 |
| 6 | 3.2 | 3.1 | 1.7 | .8 | 1.55 | 1.8 | 22 | 3.0 | 1.8 | 1.4 | 1.15 | 1.75 | 1.7 |
| 7 | 3.25 | 3.2 | 1.7 | .8 | 1.55 | 2.0 | 23 | 3.1 | 1.9 | 1.4 | 1.15 | 1.75 | 1.85 |
| 8 | 3.6 | 3.0 | 1.6 | .8 | 1.55 | 1.9 | 24 | 3.0 | 1.9 | 1.4 | 1.2 | 1.75 | 1.85 |
| 9 | 3.4 | 3.0 | 1.6 | .8 | 1.6 | 1.8 | 25 | 2.9 | 1.9 | 1.3 | 1.25 | 1.75 | 1.85 |
| 10 | 3.35 | [a]2.5 | 1.5 | .8 | 1.65 | 1.7 | 26 | 3.2 | 1.95 | 1.25 | 1.25 | 1.75 | 1.85 |
| 11 | 3.35 | 2.4 | 1.5 | .8 | 1.7 | 1.7 | 27 | 3.55 | 1.9 | 1.25 | 1.3 | 2.0 | 1.85 |
| 12 | 3.3 | 2.3 | 1.5 | .8 | 1.7 | 1.8 | 28 | 3.1 | 1.9 | 1.25 | 1.3 | 1.9 | 1.7 |
| 13 | 3.4 | 2.4 | 1.5 | .8 | 1.75 | 1.7 | 29 | 2.9 | 1.85 | 1.25 | 1.35 | 1.8 | ...... |
| 14 | 3.25 | 2.6 | 1.5 | 1.0 | 1.75 | 1.7 | 30 | 2.8 | 1.85 | 1.25 | 1.35 | 1.8 | ...... |
| 15 | 3.3 | 2.4 | 1.5 | 1.0 | 1.75 | 1.65 | 31 | 2.7 | ...... | 1.25 | 1.4 | 1.8 | ...... |
| 16 | 3.35 | 2.2 | 1.5 | 1.0 | 1.75 | 1.8 | | | | | | | |

[a] Water turned into ditch,

### LOST RIVER NEAR CLEAR LAKE, CAL.

This station was established September 1, 1904, by T. H. Humphreys. It is located about 2 miles downstream from Jessie D. Carr's Clear Lake dam, a short distance below the dam site for Clear Lake reservoir, about 20 miles from Tule Lake post-office, Cal.

The channel is straight for about 150 feet above and below the station. The current is swift. Both banks are high, rocky, and clean. There is a flood plain about 150 feet in width along the left bank. The bed of the stream is composed of rock, gravel, and soil. The channel contains a considerable growth of tules during the spring and summer months.

Discharge measurements are made during flood stages by means of a cable and car, and at low stages by wading. The initial point for soundings is the left-bank end of the cable.

A gage is painted on the vertical rock cliff on the right bank. November 4, 1905, an automatic water-height register was installed for recording gage heights. The bench mark is a mark on the rock to which the left end of the cable is anchored; elevation, 16.62 feet above the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Lost River near Clear Lake, Cal., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 26 | C. T. Darley | 102 | 92 | 1.75 | 6.30 | 161 |
| February 3 | do | 130 | 196 | 2.31 | 7.20 | 453 |
| February 7 | do | 100 | 104 | 2.08 | 6.39 | 216 |
| February 24 | do | 98 | 70 | 1.77 | 6.01 | 124 |
| March 7 | do | 102 | 102 | 1.92 | 6.35 | 196 |
| March 13 | do | 110 | 115 | 2.19 | 6.50 | 252 |
| April 3 | do | 130 | 203 | 2.64 | 7.30 | 535 |
| April 8 | do | 92 | 85 | 2.05 | 6.24 | 174 |
| April 28 | do | 14 | 12.8 | 1.88 | 5.26 | 24 |
| June 2 | do | 9.5 | 8.8 | .90 | 5.00 | 7.9 |
| September 11 | do | 10 | 8.8 | .66 | 5.02 | 5.8 |
| October 30 | do | 16 | 10.1 | .75 | 5.10 | 7.6 |

*Daily gage height, in feet, of Lost River near Clear Lake, Cal., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.4 | 7.3 | 6.3 | 6.9 | 5.3 | 5.0 | | | | | 5.1 | 5.15 |
| 2 | 5.4 | 7.8 | 6.2 | 7.5 | 5.3 | 5.0 | | | | | 5.1 | 5.15 |
| 3 | 5.4 | 7.3 | 6.3 | 7.2 | 5.2 | 5.05 | | | | | 5.1 | 5.2 |
| 4 | 5.4 | 7.1 | 6.3 | 6.9 | 5.2 | 5.1 | | | | | 5.1 | 5.2 |
| 5 | 5.4 | 6.8 | 6.4 | 6.7 | 5.1 | 5.15 | | | | | 5.1 | 5.2 |
| 6 | 5.4 | 6.5 | 6.3 | 6.6 | 5.1 | 5.2 | | | | | 5.1 | 5.2 |
| 7 | 5.4 | 6.3 | 6.5 | 6.4 | 5.15 | 5.35 | | | | | 5.1 | 5.2 |
| 8 | 5.4 | 6.1 | 6.4 | 6.2 | 5.2 | 5.6 | | | | | 5.1 | 5.15 |
| 9 | 5.4 | 5.8 | 6.3 | 6.0 | 5.2 | 5.9 | | | | | 5.1 | 5.15 |
| 10 | 5.4 | 5.6 | 6.2 | 5.8 | 5.2 | 5.8 | | | | | 5.1 | 5.15 |
| 11 | 5.4 | 5.2 | 6.2 | 5.7 | 5.3 | 5.7 | | | | | 5.1 | 5.15 |
| 12 | 5.4 | 6.05 | 6.3 | 5.8 | 5.4 | 5.6 | | | | | 5.1 | 5.15 |
| 13 | 5.4 | 6.95 | 6.5 | 5.7 | 5.35 | 5.4 | | | | | 5.1 | 5.15 |
| 14 | 5.6 | 6.9 | 6.2 | 5.5 | 5.3 | 5.25 | | | | | 5.1 | 5.15 |
| 15 | 5.8 | 6.7 | 6.1 | 5.5 | 5.25 | 5.1 | | | | | 5.1 | 5.15 |
| 16 | 6.0 | 6.2 | 6.3 | 5.55 | 5.2 | 5.0 | | | | | 5.1 | 5.2 |
| 17 | 6.25 | 5.6 | 6.9 | 5.6 | 5.15 | 5.0 | | | | | 5.1 | 5.2 |
| 18 | 6.3 | 5.5 | 6.7 | 5.6 | 5.1 | 5.0 | | | | | 5.1 | 5.2 |
| 19 | 6.3 | 5.8 | 6.3 | 5.7 | 5.05 | 5.0 | | | | | 5.1 | 5.2 |
| 20 | 6.3 | 6.4 | 6.4 | 5.5 | 5.05 | 5.0 | | | | | 5.2 | 5.2 |
| 21 | 6.35 | 6.3 | 6.6 | 5.5 | 5.0 | 5.0 | | | | | 5.15 | 5.2 |
| 22 | 6.4 | 6.2 | 6.9 | 5.5 | 5.0 | 5.0 | | | | | 5.15 | 5.2 |
| 23 | 6.4 | 6.0 | 6.9 | 5.45 | 5.0 | 5.0 | | | | | 5.15 | 5.2 |
| 24 | 6.45 | 6.1 | 6.5 | 5.4 | 4.95 | 5.0 | | | | | 5.15 | 5.2 |
| 25 | 6.5 | 6.2 | 6.3 | 5.4 | 4.9 | 5.0 | | | | | 5.15 | 5.2 |
| 26 | 6.3 | 6.0 | 6.5 | 5.5 | 4.9 | 5.0 | | | | | 5.2 | 5.2 |
| 27 | 6.0 | 6.1 | 6.9 | 5.4 | 4.95 | 5.0 | | | | | 5.2 | 5.2 |
| 28 | 6.2 | 6.2 | 6.6 | 5.3 | 5.0 | 5.0 | | | | | 5.2 | 5.2 |
| 29 | 6.4 | | 6.7 | 5.3 | 5.05 | 5.0 | | | | 5.1 | 5.15 | 5.2 |
| 30 | 6.6 | | 6.0 | 5.3 | 5.1 | 5.0 | | | | 5.1 | 5.15 | 5.2 |
| 31 | 6.8 | | 6.4 | | 5.05 | | | | | 5.1 | | 5.2 |

*Station rating table for Lost River near Clear Lake, Cal., from September 4, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.90 | 6 | 5.70 | 66 | 6.50 | 238 | 7.30 | 508 |
| 5.00 | 9 | 5.80 | 81 | 6.60 | 268 | 7.40 | 545 |
| 5.10 | 12 | 5.90 | 98 | 6.70 | 300 | 7.50 | 582 |
| 5.20 | 17 | 6.00 | 117 | 6.80 | 332 | 7.60 | 619 |
| 5.30 | 23 | 6.10 | 138 | 6.90 | 365 | 7.70 | 657 |
| 5.40 | 31 | 6.20 | 160 | 7.00 | 400 | 7.80 | 695 |
| 5.50 | 41 | 6.30 | 184 | 7.10 | 436 | 7.90 | 733 |
| 5.60 | 53 | 6.40 | 210 | 7.20 | 472 | 8.00 | 772 |

NOTE.—The above table is based on 16 discharge measurements made during 1904-5. It is farly well defined.

*Estimated monthly discharge of Lost River near Clear Lake, Cal., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| **1904.** | | | | |
| September | 20 | 9 | 11.3 | 673 |
| October | 23 | 12 | 18.1 | 1,113 |
| November | 17 | 12 | 15.5 | 923 |
| December | 27 | 14 | 18.2 | 1,119 |
| **1905.** | | | | |
| January | 332 | 31 | 120 | 7,379 |
| February | 695 | 17 | 217 | 12,050 |
| March | 365 | 117 | 224 | 13,770 |
| April | 582 | 23 | 127 | 7,557 |
| May | 31 | 6 | 14.6 | 898 |
| June | 98 | 9 | 21.6 | 1,286 |
| July | | | [a] 7.0 | 430 |
| August | | | [a] 6.0 | 369 |
| September | | | [a] 7.0 | 417 |
| October | | | [a] 10.0 | 615 |
| November | 17 | 12 | 13.0 | 774 |
| December | 12 | 14 | 16.0 | 984 |
| The year | | | 65.3 | 46,530 |

[a] Estimated.

## LOST RIVER NEAR MERRILL, OREG.

This station was established July 26, 1904, by T. H. Humphreys. It is located about 1½ miles downstream from the Stukel Bridge, 4 miles northwest of Merrill, Oreg.

The channel is straight for 200 feet above and 400 feet below the station. The current is swift at high and medium at low stages. Both banks are high and not liable to overflow. The bed of the stream is composed of clay, rock, and gravel, and is not subject to change. There is but one channel at all stages. During low water the flow over the greater portion of the section is shallow and broken, making it difficult to obtain accurate results with a current meter. Near the right bank the channel is deeper. At low water in the fall of the year a considerable growth of water grass accumulates in the channel. An old rock dam located 200 feet above the gaging station does not materially interfere with the accuracy of discharge measurements.

Discharge measurements are made at flood stages by means of a cable and car and at low water by wading. The initial point for soundings is the stream face of the left-bank cable support.

A staff gage is fastened vertically at the left bank about 40 feet upstream from the cable. During 1905 the gage was read by Mrs. Joseph Stukel. Bench marks were established as follows: (1) A large wire nail driven into post supporting cable at left bank; elevation, 17.92 feet. (2) A nail driven into the sill at the northwest corner of a granary 200 feet downstream from the cable on the right bank; elevation, 20.61 feet. Elevations refer to the datum of the gage.

Gage heights and discharge measurements taken at this station in 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Lost River near Merrill, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft per sec.* | *Feet.* | *Sec.-ft.* |
| January 18 | C. T. Darley | 87 | 82 | 1.60 | 3.50 | 131 |
| February 1 | do | 102 | 208 | 2.72 | 4.80 | 566 |
| February 8 | do | 108 | 240 | 2.74 | 5.05 | 658 |
| February 27 | do | 92 | 197 | 2.70 | 4.55 | 533 |
| March 5 | do | 96 | 199 | 2.71 | 4.63 | 540 |
| April 5 | do | 120 | 425 | 2.67 | 6.77 | 1,134 |
| April 14 | do | 90 | 140 | 2.03 | 4.00 | 284 |
| April 29 | do | 80 | 95 | 1.53 | 3.50 | 145 |
| May 12 | do | 89 | 95 | 1.37 | 3.50 | 130 |
| June 14 | do | 89 | 86 | 1.36 | 3.41 | 117 |
| July 23 | do | 90 | 86 | 1.36 | 3.45 | 117 |
| August 15 | C. T. Darley and W. B. Clapp | 88 | 82 | 1.26 | 3.41 | 103 |
| August 26 | C. T. Darley | 87 | 84 | 1.21 | 3.31 | 102 |
| September 15 | do | 87 | 83 | 1.22 | 3.32 | 101 |

*Daily gage height, in feet, of Lost River near Merrill, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.5 | 4.7 | 4.5 | 4.8 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 2 | 3.5 | 5.7 | 4.5 | 4.8 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 3 | 3.5 | 6.3 | 4.5 | 6.0 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 4 | 3.5 | 6.8 | 4.5 | 7.0 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 5 | 3.5 | 7.0 | 4.6 | 6.8 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 6 | 3.5 | 6.2 | 4.6 | 6.0 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 7 | 3.5 | 5.6 | 4.6 | 5.3 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 8 | 3.5 | 5.1 | 4.55 | 5.4 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 9 | 3.5 | 4.7 | 4.55 | 5.6 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 10 | 3.5 | 4.4 | 4.4 | 5.8 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 11 | 3.5 | 4.2 | 4.3 | 5.9 | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 12 | 3.5 | 4.0 | 4.35 | 4.0 | 3.5 | 3.55 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 13 | 3.5 | 3.9 | 4.2 | 4.0 | 3.5 | 3.55 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 14 | 3.5 | 3.8 | 4.2 | 4.0 | 3.5 | 3.55 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 15 | 3.5 | 3.8 | 4.2 | 4.0 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 16 | 3.5 | 3.7 | 4.1 | 3.9 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 17 | 3.5 | 3.7 | 4.1 | 3.9 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 18 | 3.5 | 3.7 | 4.1 | 3.8 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 19 | 3.5 | 3.7 | 4.1 | 3.8 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 20 | 3.5 | 3.8 | 4.2 | 3.8 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 21 | 3.5 | 3.8 | 4.4 | 3.7 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 22 | 3.5 | 3.9 | 4.5 | 3.7 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 23 | 3.5 | 4.4 | 4.6 | 3.7 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 24 | 3.5 | 4.4 | 4.7 | 3.6 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 25 | 4.5 | 4.5 | 4.9 | 3.6 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 26 | 5.4 | 4.5 | 4.6 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 27 | 5.3 | 4.55 | 4.6 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 28 | 5.0 | 4.55 | 5.0 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 29 | 4.7 | ....... | 4.9 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 30 | 4.5 | ....... | 4.8 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| 31 | 4.4 | ....... | 4.8 | ....... | 3.5 | ....... | 3.4 | 3.4 | ....... | 3.3 | ....... | 3.3 |

*Station rating table for Lost River near Merrill, Oreg., from July 16, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.30 | 102 | 3.60 | 176 | 3.90 | 262 | 4.20 | 362 |
| 3.40 | 125 | 3.70 | 203 | 4.00 | 294 | | |
| 3.50 | 150 | 3.80 | 232 | 4.10 | 328 | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1904–5. It is not well defined. Above gage height 4.2 feet the rating curve is a tangent, the difference being 35 per tenth

*Estimated monthly discharge of Lost River near Merrill, Oreg., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| **1904.** | | | | |
| July 26-31 | 203 | 203 | 203 | 2,415 |
| August | 203 | 176 | 199 | 12,240 |
| September | 176 | 163 | 165 | 9,818 |
| October | 163 | 150 | 158 | 9,715 |
| November | 150 | 150 | 150 | 8,926 |
| December | 150 | 150 | 150 | 9,223 |
| The period | | | | 52,330 |
| **1905.** | | | | |
| January | 782 | 150 | 248 | 15,250 |
| February | 1,342 | 203 | 514 | 28,550 |
| March | 642 | 328 | 461 | 28,350 |
| April | 1,342 | 150 | 470 | 27,970 |
| May | 150 | 150 | 150 | 9,223 |
| June | 163 | 125 | 138 | 8,212 |
| July | 125 | 125 | 125 | 7,686 |
| August | 125 | 125 | 125 | 7,686 |
| September | 102 | 102 | 102 | 6,069 |
| October | 102 | 102 | 102 | 6,272 |
| November | 102 | 102 | 102 | 6,069 |
| December | 102 | 102 | 102 | 6,272 |
| The year | 1,342 | 102 | 220 | 157,600 |

### TULE LAKE NEAR MERRILL, OREG.

This station was established May 17, 1904, by John H. Lewis and Ivan Landes for recording the water level in Tule Lake. It is located on Tule Lake at the mouth of Lost River about 3 miles east of Merrill, Oreg , 25 miles south from Klamath Falls, and near the Oregon-California line.

The gage is a vertical timber fastened to posts driven in the lake bed, about 20 feet from the shore of the lake. It is in line with the east lane fence, one-fourth mile south of the residence of J. Frank Adams. The bench mark is a notch cut in large juniper gatepost on the north side of the gate entrance about 60 feet distant from the gage rod; elevation, 13.70 feet above the zero of the gage.

*Daily gage height, in feet, of Tule Lake near Merrill, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | |
| 2 | | | | 9.25 | | | | | | | | |
| 3 | | | | | | 9.05 | 8.6 | | | | | |
| 4 | | | | | 9.2 | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | 9.1 | | | | | | | | | |
| 7 | | | | | | | | 7.95 | | | | |
| 8 | | | | | | | | | | 7.05 | 6.85 | 6.85 |
| 9 | | | | | | | | | 7.4 | | | |
| 10 | | | | | | 9.0 | 8.5 | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | 8.9 | | | | | | | | | | |
| 13 | 8.6 | | | | | | | | | | | |
| 14 | | | | | | | | 7.8 | 7.3 | | | |
| 15 | | | 9.15 | | | | | | | | | 6.7 |
| 16 | | | | | 9.15 | | | | | 7.0 | 6.8 | |
| 17 | | | | | | | 8.4 | | | | | |
| 18 | | 8.9 | | | | | | | | | | |
| 19 | | | | | | 8.95 | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | | | | | | | | 7.6 | | | | |
| 22 | | | | | | | | | 7.2 | | | |
| 23 | | | | 9.2 | 9.1 | | | | | 6.9 | 6.8 | |
| 24 | | | 9.1 | | | | 8.3 | | | | | |
| 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | 6.6 |
| 27 | | 9.0 | | | | 8.7 | | | | | | |
| 28 | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | 7.1 | 6.95 | 6.8 | |
| 31 | 8.65 | | | | | | 8.05 | 7.5 | | | | 6.55 |

NOTE.—Ice out of river, Jan. 31.

### MILLER CREEK NEAR LORELLA, OREG.

This station was established August 10, 1904, by F. S. Chapman. It is located at Horsefly, 10 miles northeast of Lorella, Oreg.

The channel is straight for 600 feet above and 100 feet below the station. The current is sluggish at low and swift at high stages. Both banks are high, rocky, wooded, and not subject to overflow. The bed of the stream is of rock and gravel, and not liable to change. The channel is obstructed by much vegetation during the season of low stage.

Discharge measurements are made during high stages by means of a cable and car, and at low stages by wading. The initial point for soundings is the stream side of the cable support on the right bank.

A staff gage is fastened vertically at the right bank, 300 feet upstream from the cable, where the water stands in a pool. During 1905 the gage was read by Louis Gerber. On December 9, 1905, an automatic water-height register was installed for recording gage heights. The bench mark is a point on top of a large bowlder 25 feet downstream from the gage; elevation, 12.68 feet above the datum of the gage.

Gage heights and discharge measurements taken at this station during 1904 are contained in Water-Supply Paper No. 134, United States Geological Survey.

*Discharge measurements of Miller Creek near Lorella, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| January 28 | C. T. Darley | 110 | 72 | 2.03 | 7.25 | 146 |
| February 4 | do | 124 | 86 | 1.87 | 7.30 | 161 |
| February 6 | do | 90 | 58 | 1.50 | 6.99 | 87 |
| February 25 | do | 118 | 88 | 2.01 | 7.30 | 177 |
| March 8 | do | 91 | 72 | 1.72 | 7.14 | 124 |
| March 15 | F. S. Chapman | 90 | 65 | 1.46 | 6.92 | 95 |
| April 2 | C. T. Darley | 130 | 155 | 2.97 | 8.00 | 460 |
| April 9 | do | 72 | 47 | 1.32 | 6.88 | 62 |
| April 28 | do | 18 | 10.8 | .29 | 6.19 | 3.1 |
| June 1 | do | 20 | 11.2 | .18 | 6.11 | 2.0 |

*Daily gage height, in feet, of Miller Creek near Lorella, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.3 | 8.0 | 7.2 | 7.0 | 6.3 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... |
| 2 | 6.3 | 8.2 | 7.2 | 8.0 | 6.3 | 6.1 | ...... | ...... | ...... | ...... | ...... | ...... |
| 3 | 6.3 | 7.7 | 7.3 | 7.8 | 6.3 | 6.1 | ...... | ...... | ...... | ...... | ...... | ...... |
| 4 | 6.3 | 7.3 | 7.3 | 7.6 | 6.3 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... |
| 5 | 6.3 | 7.7 | 7.3 | 7.4 | 6.3 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... |
| 6 | 6.3 | 7.0 | 7.2 | 7.2 | 6.3 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... |
| 7 | 6.3 | 7.0 | 7.2 | 7.0 | 6.2 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... |
| 8 | 6.3 | 7.0 | 7.2 | 6.9 | 6.2 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... |
| 9 | 6.3 | 7.0 | 7.1 | 6.8 | 6.4 | 6.3 | ...... | ...... | ...... | ...... | ...... | [a] 6.0 |
| 10 | 6.3 | 6.9 | 7.1 | 6.8 | 6.4 | 6.3 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 11 | 6.3 | 6.6 | 7.0 | 6.8 | 6.4 | 6.3 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 12 | 6.3 | 6.5 | 7.1 | 6.6 | 6.4 | 6.3 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 13 | 6.3 | 6.5 | 7.1 | 6.6 | 6.4 | 6.2 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 14 | 6.3 | 6.4 | 7.1 | 6.5 | 6.4 | 6.2 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 15 | 6.3 | 6.4 | 6.8 | 6.5 | 6.3 | 6.2 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 16 | 7.5 | 6.4 | 7.3 | 6.6 | 6.3 | 6.2 | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 17 | 7.6 | 6.4 | 7.3 | 6.6 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 18 | 7.7 | 6.4 | 7.3 | 6.6 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 19 | 7.5 | 6.8 | 7.4 | 6.5 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 20 | 7.5 | 7.2 | 7.4 | 6.5 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 21 | 7.5 | 7.3 | 7.1 | 6.5 | 6.1 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 22 | 7.9 | 7.3 | 7.3 | 6.4 | 6.0 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 23 | 8.2 | 7.3 | 7.3 | 6.4 | 6.0 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 24 | 7.9 | 7.3 | 7.2 | 6.4 | 6.0 | ...... | ...... | ...... | ...... | ...... | 6.0 | 6.0 |
| 25 | 7.9 | 7.3 | 7.2 | 6.3 | 5.9 | ...... | ...... | ...... | ...... | ...... | 6.1 | 6.0 |
| 26 | 7.7 | 7.3 | 7.9 | 6.3 | 6.1 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 27 | 7.7 | 7.3 | 7.5 | 6.2 | 6.1 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 28 | 7.3 | 7.3 | 7.4 | 6.2 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 29 | 7.5 | ...... | 7.4 | 6.2 | 6.3 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 30 | 8.0 | ...... | 7.2 | 6.2 | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... | 6.0 |
| 31 | 8.3 | ...... | 7.2 | ...... | 6.2 | ...... | ...... | ...... | ...... | ...... | ...... | ...... |

[a] New gage.

NOTE.—No flow June 17 to December 31

*Station rating table for Miller Creek near Lorella, Oreg., from August 7, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.00 | 0 | 6.80 | 52 | 7.60 | 274 | 8.40 | 665 |
| 6.10 | 1.5 | 6.90 | 67 | 7.70 | 317 | 8.50 | 717 |
| 6.20 | 4 | 7.00 | 86 | 7.80 | 363 | 8.60 | 770 |
| 6.30 | 8 | 7.10 | 109 | 7.90 | 411 | 8.70 | 823 |
| 6.40 | 13 | 7.20 | 135 | 8.00 | 460 | 8.80 | 876 |
| 6.50 | 20 | 7.30 | 163 | 8.10 | 510 | 8.90 | 929 |
| 6.60 | 29 | 7.40 | 196 | 8.20 | 561 | 9.00 | 982 |
| 6.70 | 39 | 7.50 | 234 | 8.30 | 613 | | |

NOTE.—The above table is based on 13 discharge measurements made during 1904-5. It is well defined between gage heights 6.1 feet and 8 feet.

*Estimated monthly discharge of Miller Creek near Lorella, Oreg., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| August | 1.5 | .75 | 1.3 | 79 |
| September | 1.5 | .0 | .2 | 12 |
| October | 8 | 1.5 | 2.4 | 148 |
| November | 8 | 1.5 | 3.7 | 221 |
| December | 10.5 | 1.5 | 6.2 | 381 |
| The period | ........ | ........ | ........ | 841 |
| 1905. | | | | |
| January | 613 | 8 | 179 | 11,010 |
| February | 561 | 13 | 138 | 7,664 |
| March | 411 | 52 | 153 | 9,408 |
| April | 460 | 4 | 71.0 | 4,225 |
| May | 13 | 0 | 6.5 | 400 |
| June | 8 | 0 | 3.0 | 179 |
| July | 0 | 0 | .0 | 0 |
| August | 0 | 0 | .0 | 0 |
| September | 0 | 0 | .0 | 0 |
| October | 0 | 0 | .0 | 0 |
| November | 0 | 0 | .0 | 0 |
| December | 0 | 0 | .0 | 0 |
| The year | 613 | 0 | 46. | 32,890 |

### PRECIPITATION AND EVAPORATION DATA.

The following table gives the total precipitation in inches, by months, and also the annual totals:

| | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Keno, Oreg.: | | | | | | | | | | | | | |
| 1904 | | | | | | | | 0.00 | 1.58 | 2.08 | 1.50 | 3.57 | ........ |
| 1905 | 2.08 | 1.91 | 2.30 | 0.66 | 2.29 | 0.15 | 0.00 | 0.00 | 0.75 | 0.72 | 1.30 | 2.23 | 14.39 |
| Tule Lake, Cal.: | | | | | | | | | | | | | |
| 1904 | | | | | | | | 0.00 | 0.92 | 1.01 | 0.42 | 3.11 | ........ |
| 1905 | 1.25 | 1.19 | 1.70 | 0.20 | 2.62 | 0.30 | 0.00 | 0.00 | 0.42 | ...... | 1.25 | 0.93 | ........ |
| Horse Fly, near Lorella, Oreg.: | | | | | | | | | | | | | |
| 1904 | | | | | | | | 0.00 | 0.71 | 1.11 | 1.07 | 2.61 | ........ |
| 1905 | 1.43 | 1.09 | 2.22 | 0.28 | 2.56 | 1.23 | 0.00 | 0.00 | 0.32 | 0.32 | 0.83 | 2.41 | 12.69 |

The following table gives the total evaporation in inches, by months, at Keno, Oreg.:

| Year. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1904 | | | | | | | | 6.66 | 5.12 | 2.01 | 2.01 | 2.01 | ........ |
| 1905 | 1.19 | 0.78 | 0.78 | 2.69 | 4.12 | 6.20 | 7.57 | 7.03 | 6.15 | 1.98 | 0.46 | ...... | ........ |

### MISCELLANEOUS MEASUREMENTS IN NORTHERN PACIFIC OCEAN DRAINAGE BASIN.

*Antelope Creek near Mount Hebron, Cal.*—This creek rises on the eastern slope of Mount Shasta. It is tributary to Lower Klamath Lake, although its waters sink before reaching the lake. A measurement was made June 17 by C. T. Darley, 12 miles below its source.

Width, 25.5 feet; area, 37 square feet; mean velocity, 3.03 feet per second; discharge, 112 second-feet.

Another measurement was made August 28 by C. T. Darley 15 miles below its source.

Width, 13 feet; area, 9.4 square feet; mean velocity, 1.11 feet per second; discharge, 10.4 second-feet.

*Adams ditch near Merrill, Oreg.*—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is common with the Van Brimmer canal. It is about 16 miles in length and is used for the irrigation of land in the vicinity of Merrill, Oreg. The following measurements were made during 1905 at a point one mile below the head of the canal and 300 feet below the point where the Adams and Van Brimmer canals separate. The gage rod is a 1 by 4 inch timber divided into feet and hundredths. There is no bench mark.

May 14: Width, 36 feet; area, 42 square feet; mean velocity, 1.10 feet per second; gage height, 1.73 feet; discharge, 46 second-feet.

May 21: Width, 37.6 feet; area, 47 square feet; mean velocity, 1.13 feet per second; gage height, 1.90 feet; discharge, 53 second-feet.

June 15: Width, 37.5 feet; area, 40 square feet; mean velocity, 1.28 feet per second; gage height, 2.14 feet; discharge, 51 second-feet.

July 22: Width, 37.5 feet; area, 43 square feet; mean velocity, 1.19 feet per second; gage height, 2.22 feet; discharge, 51 second-feet.

August 24: Width, 37.5 feet; area, 36 square feet; mean velocity, 1.03 feet per second; gage height, 2.13 feet; discharge, 37 second-feet.

August 25: Width, 36.7 feet; area, 32 square feet; mean velocity, 0.91 foot per second; gage height, 2.00 feet; area, 29 second-feet.

August 25: Width, 37.9 feet; area, 39 square feet: mean velocity, 1.05 feet per second; gage height, 2.26 feet; discharge, 41 second-feet.

*Ankeny ditch, station No. 1, near Klamath Falls, Oreg.*—Ankeny canal diverts water from Link River at the outlet of Upper Klamath Lake, 1½ miles above the town of Klamath Falls, Oreg. The water from this canal is used for electric power and irrigation purposes in the vicinity of Klamath Falls. This station is located about 500 feet above point of diversion to electric power plant. Discharges here given represent the amount of water used for both electric power and irrigation purposes. The following measurements were made during 1905 by C. T. Darley.:

June 29: Width, 17.4 feet; area, 21 square feet; mean velocity, 2.71 feet per second; gage height, 1.36 feet; discharge, 57 second-feet.

June 30: Width, 17.4 feet; area, 20 square feet; mean velocity, 2.70 feet per second; gage height, 1.34 feet; discharge, 54 second feet.

May 11: Width, 17.5 feet; area, 22 square feet; mean velocity, 2.86 feet per second; gage height, 1.39 feet; discharge, 63 second-feet.

June 29: Width, 17.4 feet; area, 21 square feet; mean velocity, 2.52 feet per second; gage height, 1.36 feet; discharge, 53 second-feet.

*Ankeny canal station No. 2, near Klamath Falls, Oreg.*—This station is located about 200 feet below point of diversion by electric power plant. Discharges here given represent the amount of water used for irrigation purposes.

April 23: Width, 13.5 feet; area, 7.0 square feet; mean velocity, 1.24 feet per second; gage height, 1.28 feet; discharge, 8.7 second-feet.

May 2: Width, 13.5 feet; area, 13.1 square feet; mean velocity, 2.21 feet per second; gage height, 1.68 feet; discharge, 29 second-feet.

May 11: Width, 13.5 feet; area, 15 square feet; mean velocity, 2.33 feet per second; gage height, 1.80 feet; discharge, 35 second-feet.

*Butte Creek near Mount Hebron, Cal.*—Butte Creek rises on the eastern slope of Mount Shasta. It is tributary to Lower Klamath Lake and its waters sink in Butte Valley before reaching the lake. This creek discharges over fissured lava and large quantities of water are lost by seepage. That portion which reaches Butte Valley is used for irrigation. The following measurements were made during 1905 by C. T. Darley, 1½ miles above Boyce ranch at county road crossing.

May 5: Width, 15.5 feet; area, 51 square feet; mean velocity, 1.33 feet per second; gage height, 3.77 feet; discharge, 68 second-feet.

May 19: Width, 15.9 feet; area, 51 square feet; mean velocity, 1.47 feet per second; gage height, 3.95 feet; discharge, 75 second-feet.

June 16: Width, 16 feet; area, 48 square feet; mean velocity, 1.08 feet per second; gage height, 3.72 feet; discharge, 52 second-feet.

August 29: Width, 14 feet; area, 35 square feet; mean velocity, 0.47 foot per second; gage height, 3.00 feet; discharge, 16.4 second-feet.

November 23: Width, 14 feet; area, 36 square feet; mean velocity, 0.23 foot per second; gage height, 3.30 feet; discharge, 8.1 second-feet.

*Bowne's west canal, near Bonanza, Oreg.*—This canal takes water from Lost River, the water being raised by means of pumps and used for irrigation in the vicinity of Bonanza, Oreg. A measurement was made on May 31 by C. T. Darley at a point 300 feet below head of flume.

Width, 9.5 feet; area, 5.9 square feet; mean velocity, 1.46 feet per second; discharge, 8.6 second-feet.

*Boards ditch, Poe Valley, Oreg.*—This ditch diverts water from Lost River. The water is raised by means of a water wheel and is used for irrigation in the vicinity of Olene, Oreg. A measurement was made on July 19 by C. T. Darley at a point 300 feet below head of canal.

Width, 2 feet; area, 1.56 square feet; mean velocity, 0.22 foot per second; discharge, 0.3 second-foot.

*Coyote Creek, Oreg.*—Coyote Creek is tributary to Sycan marsh. During 1905 discharge measurements were made by Ivan Landes as follows:

March 15: Width, 5.5 feet; area, 4.7 square feet; mean velocity, 0.89 foot per second; discharge, 4.2 second-feet.

April 10: Width, 6.0 feet; area, 6.1 square feet; mean velocity, 1.34 feet per second; discharge, 8.2 second-feet.

May 2: Width, 6.0 feet; area, 5.6 square feet; mean velocity, 1.05 feet per second; discharge, 5.9 second-feet.

June 12: Width, 5.0 feet; area, 3.4 square feet; mean velocity, 0.50 foot per second; discharge, 1.7 second-feet.

July 31: Width, 1.4 feet; area, 0.4 square foot; mean velocity, 1.38 feet per second; discharge, 0.6 second-foot.

*Crooked Creek near Klamath Agency, Oreg.*—This stream is a tributary of Wood River. A measurement was made May 27 by C. T. Darley at the bridge 1½ miles from Klamath Agency, on road to Fort Klamath.

Width, 24.8 feet; area, 88 square feet; mean velocity, 0.52 foot per second; discharge, 46 second-feet.

*Cherry Creek near Crystal, Oreg.*—This stream is tributary to Upper Klamath Lake from the west. A measurement was made on May 25 by C. T. Darley at road crossing between Pelican Bay and Fort Klamath.

Width, 27 feet; area, 25 square feet; mean velocity, 1.28 feet per second; discharge, 32 second-feet.

*Crane Creek near Fort Klamath, Oreg.*—Crane Creek is a tributary to Seven Mile Creek. A measurement was made on May 25 by C. T. Darley at the bridge on wagon road between Fort Klamath and Pelican Bay, Oreg.

Width, 11.5 feet; area, 20 square feet; mean velocity, 0.54 foot per second; discharge, 10.7 second-feet.

*Cottonwood Creek near Brownell, Cal.*—Cottonwood Creek is tributary to Lower Klamath Lake from the South. The following measurements were made during 1905, 1 mile below its source, at "F" ranch, Brownell:

June 15: Width, 19.5 feet; area, 41 square feet; mean velocity, 0.25 foot per second; discharge, 10.2 second-feet.

August 30: Width, 27.5 feet; area, 24 square feet; mean velocity, 0.53 foot per second; discharge, 12.6 second-feet.

*Doris Creek near Picard, Cal.*—Doris Creek is tributary to Lower Klamath Lake from the southwest. A measurement was made on June 18 by C. T. Darley at the Doris ranch.

Width, 5.4 feet; area, 4.9 square feet; mean velocity, 1.24 feet per second; discharge, 6.1 second-feet.

*Dirty Creek, Oregon.*—Dirty Creek is tributary to Sycan marsh. During 1905 discharge measurements were made by Ivan Landes, as follows:

March 15: Width, 3.0 feet; area, 1.4 square feet; mean velocity, 0.98 foot per second; discharge, 1.4 second-feet.

April 10: Width, 3.0 feet; area, 1.5 square feet; mean velocity, 0.99 foot per second; discharge, 1.3 second-feet.

May 2: Width, 3.0 feet; area, 1.4 square feet; mean velocity, 1.0 foot per second; discharge, 1.4 second-feet.

*Edson Foulks ditch.*—This ditch is in Shasta Valley. A measurement was made at head of ditch September 3, 1905, by L. G. Applegate.

Width, 6.3 feet; area, 6.3 square feet; mean velocity, 1.75 feet per second; discharge, 11 second-feet.

*Four Mile Creek, Pelican Bay, Oregon.*—Four Mile Creek is tributary to Upper Klamath Lake from the west. Its source is in Four Mile Lake. A measurement was made May 24 by C. T. Darley at road crossing between Klamath Falls and Pelican Bay.

Width, 50.5 feet; area, 75 square feet; mean velocity, 0.70 foot per second; discharge, 53 second-feet.

*Grass Valley Creek near Lowden, Cal.*—Grass Valley Creek is tributary to Trinity River. A measurement was made of this stream August 26, 1905, by W. B. Clapp at lower wagon bridge on Buckhorn road 2½ miles above junction of creek with Trinity River.

Width, 19 feet; area, 18.7 square feet; mean velocity, 0.98 foot per second; discharge, 18.4 second-feet.

*Griffith canal near Olene, Oreg.*—This canal diverts water from Lost River. The water is raised by means of a water wheel and used for irrigation of land in the vicinity of Olene. The following measurements were made during 1905 by C. T. Darley at head of canal:

June 2: Width, 2 feet; area, 1.4 square feet; mean velocity, 1.29 feet per second; discharge, 1.8 second-feet.

June 13: Width, 2 feet; area, 1.5 square feet; mean velocity, 1.27 feet per second; discharge, 1.9 second-feet.

June 25: Width, 2 feet; area, 1.16 square feet; mean velocity, 1.08 feet per second; discharge, 1.3 second-feet.

*Hot Springs Creek near Klamath Falls, Oreg.*—Hot Springs Creek rises about one-half mile east of Klamath Falls and discharges into Lower Klamath Lake. A measurement was made on August 18 by C. T. Darley near point where creek crosses county road east of Klamath Falls, Oreg.

Width, 1.5 feet; area, 0.36 square foot; mean velocity, 0.94 foot per second; discharge, 4.4 second-feet.

*Horton ditch at Poe Valley, Oreg.*—This ditch diverts water from Lost River, which is used for irrigation on the south side of the river. A measurement was made on June 23 by C. T. Darley at a point one-fourth of a mile below head of ditch.

Width, 7.5 feet; area, 7.4 square feet; mean velocity, 0.59 foot per second; discharge, 4.4 second-feet.

*Little Shasta River at Little Shasta, Cal.*—A measurement of this stream was made August 29, 1905, by M. D. Williams.

Width, 9 feet; area, 5.4 square feet; mean velocity, 0.70 foot per second; discharge, 3.8 second-feet.

*Little Shasta Springs at Little Shasta, Cal.*—A measurement was made August 29, 1905, by M. D. Williams.

Width, 9 feet; area, 5.6 square feet; mean velocity, 3.57 feet per second; discharge, 20 second-feet.

*Long Creek, Oreg.*—Long Creek is tributary to Sycan Marsh. During 1905 discharge measurements were made by Ivan Landes as follows:

March 15: Width, 22 feet; area, 21.8 square feet; mean velocity, 1.54 feet per second; discharge, 33.6 second-feet.

April 10: Width, 25 feet; area, 36.9 square feet; mean velocity, 1.48 feet per second; discharge, 54.6 second-feet.

May 1: Width, 26 feet; area, 46.8 square feet; mean velocity, 1.45 feet per second; discharge, 68.1 second-feet.

June 12: Width, 25 feet; area, 37.6 square feet; mean velocity, 1.56 feet per second; discharge, 58.6 second-feet.

July 31: Width, 20 feet; area, 10.8 square feet; mean velocity, 1.72 feet per second; discharge, 18.6 second-feet.

*Moss Creek near Pelican Bay, Oregon.*—Moss Creek is tributary to Upper Klamath Lake from the west. A measurement was made on May 23 by C. T. Darley at road crossing between Pelican Bay and Klamath Falls, Oreg.

Width, 5.5 feet; area, 3.3 square feet; mean velocity, 0.76 foot per second; discharge, 2.5 second-feet.

*McCormick mill-race canal near Keno, Oreg.*—This canal diverts water from Klamath River about 1 mile below Keno, Oreg. This water is used for power purposes in running a sawmill. The following measurements were made during 1905 by C. T. Darley at a point one-fourth of a mile below head of canal:

June 19: Width, 17 feet; area, 43 square feet; mean velocity, 1.51 feet per second; discharge, 64 second-feet.

August 31: Width, 14.5 feet; area, 25 square feet; mean velocity, 2.12 feet per second; discharge, 53 second-feet.

*Moore's power canal near Klamath Falls, Oreg.*—This canal diverts water from the head of Link River and is used for power purposes in running a sawmill. The following measurement was made by C. T. Darley at a point one-half mile below head of canal:

March 25: Width, 9.9 feet; area, 34 square feet; mean velocity, 3.03 feet per second; discharge, 103 second-feet.

At a point 200 feet above Penstock the following measurements were made:

March 25: Width, 9 feet; area, 35 square feet; mean velocity, 2.14 feet per second; discharge, 75 second-feet.

June 21: Width, 9.5 feet; area, 34 square feet; mean velocity, 1.74 feet per second; discharge, 59 second-feet.

June 21: Width, 9.5 feet; area, 34 square feet; mean velocity, 1.56 feet per second; discharge, 53 second-feet.

*Moore's irrigation canal near Klamath Falls, Oreg.*—This canal diverts water from the head of Link River at same point at which water is diverted for Moore's mill-race canal on the west bank. This water is used for power purposes in running sawmill and the irrigation of town lots in the west addition of Klamath Falls, Oreg. The following measurements were made during 1905 by C. T. Darley at a point 300 feet below head of canal. These measurements show total amount of water used for power and irrigation purposes in this canal.

March 25: Width, 10 feet; area, 15.8 square feet; mean velocity, 0.82 foot per second; discharge, 12.9 second-feet.

June 21: Width, 12.4 feet; area, 10.1 square feet; mean velocity, 1.08 feet per second; discharge, 10.9 second-feet.

*Phillip's wheel canal near Spring Lake, Oregon.*—This canal diverts water from Lost River about 9 miles above Merrill, Oreg. The water is raised from the river by means of a water wheel and is used for irrigation purposes. The following measurements were made during 1905 by C. T. Darley at a point in flume 100 feet below point of diversion.

June 13: Width, 3 feet; area, 1.2 square feet; mean velocity, 1.00 foot per second; discharge, 1.2 second-feet.

July 25: Width, 1.2 feet; area, 0.1 square foot; discharge, 0.2 second-foot.

*Rock Creek near Aspin Lake, Oregon.*—This portion of Rock Creek is tributary to Upper Klamath Lake and has its source in Aspin Lake. A measurement was made on May 23 by C. T. Darley at bridge on wagon road between Klamath Falls and Pelican Bay.

Width, 23.5 feet; area, 16.9 square feet; mean velocity, 0.57 foot per second; discharge, 9.6 second-feet.

*Rock Creek at Crystal, Oreg.*—This stream is tributary to Crystal Creek and is a separate stream from the Rock Creek which discharges from Aspin Lake. A measurement was made on May 24 by C. T. Darley at bridge on wagon road between Klamath Falls and Pelican Bay.

Width, 19 feet; area, 8.9 square feet; mean velocity, 0.66 foot per second; discharge, 5.9 second-feet.

*Scott River near Fort Jones, Cal.*—Scott River is tributary to Klamath River. A measurement of this stream was made August 29, 1905, by W. B. Clapp 500 feet above wagon bridge on main road from Fort Jones to Etna, about 1 mile west from Fort Jones.

Width, 27 feet; area, 23 square feet; mean velocity, 1.17 feet per second; discharge, 27 second-feet.

*Seven Mile Creek near Fort Klamath, Oreg.*—This creek is tributary to Upper Klamath Lake from the north. A measurement was made on May 25 by C. T. Darley at bridge on wagon road between Fort Klamath and Pelican Bay.

Width, 33 feet; area, 129 square feet; mean velocity, 0.79 foot per second; discharge, 102 second-feet.

*Shasta River near Yreka, Cal.*—Shasta River is tributary to Klamath River. A measurement of this stream was made August 29, 1905, by W. B. Clapp 5 miles northeast of Yreka and 500 feet below diversion dam of the Yreka Light and Power Company.

Width, 11.5 feet; area, 8.2 square feet; mean velocity, 1.22 feet per second; discharge, 10 second-feet.

There was on this date 107 second-feet being diverted into canal 500 feet above this point, giving a total discharge of 117 second-feet for this stream.

*Sheepy Creek near Brownell, Cal.*—This creek is tributary to Lower Klamath Lake from the southwest. The following measurements were made during 1905 by C. T. Darley at a point 2 miles east of Doris ranch, at wagon bridge near rock ford:

May 18: Width, 78 feet; area, 226 square feet; mean velocity, 0.12 foot per second; discharge, 27 second-feet.

June 18: Width, 80 feet; area, 218 square feet; mean velocity, 0.12 foot per second; discharge, 27 second-feet.

*Sprague River near Yainax, Oreg.*—Sprague River is tributary to Williamson River. A measurement was made on February 22 by C. T. Darley at bridge 5 miles below Yainax Agency. The gage is a 2 by 8 inch plank graduated to feet and tenths and nailed in a vertical position on the downstream side of the second bent from the south end of the bridge. The bench mark is a 2 by 4 inch stake driven flush with the ground on left bank of the stream in line with upstream side of the bridge and distant 74 feet from end of bridge. The zero of the gage is 21.9 feet below the bench mark.

Width, 133.2 feet; area, 1,077 square feet; mean velocity, 0.55 foot per second; discharge, 589 second-feet; gage height, 14.10 feet.

*Spring Creek near Fort Klamath, Oreg.*—This creek is tributary to Williamson River from the west. A measurement was made on August 13 by J. B. Lippincott and W. B. Clapp at a point 200 feet above its junction with Williamson River.

Width, 110 feet; area, 195 square feet; mean velocity, 1.86 feet per second; discharge, 362 second-feet.

*Swingle flume canal near Lorella, Oreg.*—This canal diverts water from Miller Creek above Lorella Bridge. The water is used for irrigation purposes in the vicinity of Lorella. A measurement was made on June 2 by C. T. Darley in small flume at road crossing on Langell Valley and Lorella road.

Width, 2 feet; area, 1.0 square foot; mean velocity, 0.20 foot per second; discharge, 0.2 second-foot.

*Three Mile Creek near Fort Klamath, Oreg.*—This creek is tributary to Upper Klamath Lake from the northwest. A measurement was made on May 25 by C. T. Darley at crossing of wagon road between Fort Klamath and Pelican Bay.

Width, 13.2 feet; area, 6.2 square feet; mean velocity, 1.00 foot per second; discharge, 6.2 second-feet.

*Trinity River near Lowden, Cal.*—Trinity River is tributary to Klamath River. A measurement of this stream was made August 26, 1905, by W. B. Clapp from a temporary pontoon bridge 1 mile above Lowden's ranch post-office and 3 miles below Lewiston, Cal. A permanent county highway bridge was being constructed at this point.

Width, 190 feet; area, 468 square feet; mean velocity, 0.50 foot per second; discharge, 233 second-feet.

*Varney Creek near Pelican Bay, Oregon.*—Varney Creek is tributary to Four Mile Creek. A measurement was made May 24 by C. T. Darley at road crossing between Pelican Bay and Klamath Falls.

Width, 9 feet; area, 13 square feet; mean velocity, 0.70 foot per second; discharge, 9.1 second-feet.

*Van Brimmer ditch, south branch, station No. 1, near Merrill, Oreg.*—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is common with the Adams canal. This water is used for irrigation in the vicinity of Merrill, Oreg. The following measurements were made on this branch by C. T. Darley during 1905 at point 1 mile below the head of canal and at a point 300 feet below where Adams and Van Brimmer canals become separate and distinct. The gage rod is a 1 by 4 inch inclined timber graduated to feet and hundredths and nailed to posts set firmly in the bank of the canal. There is no bench mark.

May 14: Width, 20 feet; area, 23 square feet; mean velocity, 1.04 feet per second; gage, 4.01 feet; discharge, 24 second-feet.

May 21: Width, 18 feet; area, 17.2 square feet; mean velocity, 1.22 feet per second; gage, 3.78 feet; discharge, 21 second-feet.

June 14: Width, 18.6 feet; area, 16 square feet; mean velocity, 1.28 feet per second; gage, 3.92 feet; discharge, 20 second-feet.

July 22: Width, 18.3 feet; area, 13.9 square feet; mean velocity, 0.83 foot per second; gage, 3.84 feet; discharge, 11.5 second-feet.

August 24: Width, 17.5 feet; area, 10.4 square feet; mean velocity, 0.72 foot per second; gage, 3.72 feet; discharge, 7.5 second-feet.

August 24: Width, 18.2 feet; area, 12.3 square feet; mean velocity, 0.80 foot per second; gage, 3.85 feet; discharge, 9.9 second-feet.

August 25: Width, 19.8 feet; area, 17.9 square feet; mean velocity, 0.91 foot per second; gage, 4.12 feet; discharge, 16.3 second-feet.

August 25: Width, 16.5 feet; area, 5.3 square feet; mean velocity, 0.49 foot per second; gage, 3.40 feet; discharge, 2.6 second-feet.

August 25: Width, 17.0 feet; area, 6.9 square feet; mean velocity, 0.62 foot per second; gage, 3.55 feet; discharge, 4.3 second-feet.

*Van Brimmer ditch, north branch, station No. 2, near Merrill, Oreg.*—This canal diverts water from White Lake, an arm of Lower Klamath Lake. For the first mile this canal is common with the Adams canal. The following measurements were made of this branch during 1905 by C. T. Darley at a point 1 mile below heading and 300 feet below where Adams and Van Brimmer canals become separate and distinct. The gage is a 1 by 4 inch timber graduated to tenths and half tenths. It is set firmly to posts driven in the ground on the right bank. There is no bench mark.

May 14: Width, 13.8 feet; area, 8 square feet; mean velocity, 0.75 foot per second; gage, 1.95 feet; discharge, 6 second-feet.

May 21: Width, 14.3 feet; area, 7.5 square feet; mean velocity, 0.83 foot per second; gage, 1.99 feet; discharge, 6.2 second-feet.

June 15: Width, 15.4 feet; area, 7.4 square feet; mean velocity, 1.03 feet per second; gage, 2.21 feet; discharge, 7.6 second-feet.

July 24: Width, 16.5 feet; area, 10.4 square feet; mean velocity, 0.93 foot per second; gage, 2.34 feet; discharge 9.7 second-feet.

July 24: Width, 16.5 feet; area, 10.2 square feet; mean velocity, 0.93 foot per second; gage, 2.34 feet; discharge, 9.5 second-feet.

August 24: Width, 15.5 feet; area, 5.6 square feet; mean velocity, 0.79 foot per second; gage, 2.20 feet; discharge, 4.6 second-feet.

*Willow Creek near Brownell, Cal.*—Willow Creek is tributary to Lower Klamath Lake from the south. The following measurements were made during 1905 at bridge on Merrill and Brownell road by C. T. Darley:

May 20: Width, 20 feet; area, 17.2 square feet; mean velocity, 0.72 foot per second; discharge, 12.3 second-feet.

June 15 Width, 35.5 feet; area, 24 square feet; mean velocity, 0.48 foot per second; discharge, 11.5 second-feet.

August 30: Width, 18 feet; area, 13.9 square feet; mean velocity, 0.70 foot per second; discharge, 9.7 second-feet.

November 23: Width, 10 feet; area, 12.6 square feet; mean velocity, 0.87 foot per second; discharge, 11 second-feet.

*Williamson River near Klamath Agency, Oreg.*—This stream is tributary to Upper Klamath Lake from the north. The following measurements were made during 1905 at bridge on county road between Klamath Falls and Fort Klamath, Oreg.:

May 27: Width, 175.8 feet; area, 1,532 square feet; mean velocity, 0.89 foot per second; discharge, 1,371 second-feet.

August 22: Width, 176 feet; area, 1,479 square feet; mean velocity, 0.58 foot per second; discharge, 858 second-feet.

At Chillaquin Bridge on road between Klamath Agency and Yainax Agency, November 14: Width, 40 feet; area, 230 square feet; mean velocity, 2.72 feet per second; discharge, 625 second-feet.

*Wood River near Fort Klamath, Oreg.*—Wood River is tributary to Upper Klamath Lake from the north. The following measurements were made during 1905 by C. T. Darley at bridge on county road, 4 miles below Fort Klamath, Oreg.:

May 27: Width, 52.3 feet; area, 297 square feet; mean velocity, 1.54 feet per second; discharge, 458 second-feet.

At bridge one-fourth mile below Fort Klamath, Oreg.:

August 22: Width, 47.6 feet; area, 166 square feet; mean velocity, 1.60 feet per second; discharge, 266 second-feet.

November 14: Width, 49 feet; area, 162 square feet; mean velocity, 1.59 feet per second; discharge, 259 second-feet.

December 10: Width, 49 feet; area, 162 square feet; mean velocity, 1.69 feet per second; discharge, 274 second-feet.

*Yreka Light and Power Company's canal near Yreka, Cal.*—A measurement of this canal was made August 29, 1905, by W. B. Clapp from footbridge at house 500 feet below concrete diversion dam at head of canal and distant about 5 miles northeast from Yreka. This canal diverts water from Shasta River.

Width, 17.5 feet; area, 36 square feet; mean velocity, 2.97 feet per second; discharge, 107 second-feet.

For total flow of Shasta River see measurement made same date below diversion dam.

## ROGUE RIVER DRAINAGE BASIN.

### ROGUE RIVER AT GOLD RAY, OREG.

This station was established August 30, 1905, by L. R. Allen. It is located at Gold Ray, Oreg., 1½ miles below Tolo post-office, just below the Condor Water and Power Company's dam and bridge, and a short distance below the mouth of Stewart Creek.

The channel is straight for 400 feet above and 300 feet below the station. The current at the measuring section is uniform. Both banks are high and rocky and are covered with a light growth of brush. The bed of the stream is rocky, somewhat broken in places, free from vegetation, and permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point is a tag on the tagged wire, 6.2 feet from the cable support on the left bank.

The gage is a vertical staff bolted to concrete pier of bridge about 300 feet above the cable. During 1905 the gage heights were furnished by the Condor Water and Power Company, observations being taken twice each day by C. E. Wertz. The bench mark is the top of the anchor bolt for stay line on the right bank. This bolt is well wedged in solid rock; elevation, 21.34 feet above the datum of the gage.

*Discharge measurements of Rogue River at Gold Ray, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| August 30 | L. R. Allen | 180 | 1,013 | 1.29 | 1.10 | 1,307 |
| October 17 | do | 180 | 1,023 | 1.18 | 1.20 | 1,210 |
| December 26 | do | 184 | 1,100 | 1.38 | 1.57 | 1,514 |

*Daily gage height, in feet, of Rogue River at Gold Ray, Oreg., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 1.2 | 1.2 | 1.32 | 17 | 1.2 | 1.25 | 1.22 | 1.32 |
| 2 | 1.1 | 1.17 | 1.2 | 1.3 | 18 | 1.1 | 1.25 | 1.3 | 1.4 |
| 3 | 1.1 | 1.15 | 1.2 | 1.3 | 19 | 1.1 | 1.25 | 1.3 | 1.45 |
| 4 | 1.15 | 1.15 | 1.2 | 1.27 | 20 | 1.05 | 1.25 | 1.5 | 1.47 |
| 5 | 1.15 | 1.17 | 1.2 | 1.45 | 21 | 1.05 | 1.25 | 1.3 | 1.4 |
| 6 | 1.12 | 1.3 | 1.2 | 1.32 | 22 | 1.1 | 1.25 | 1.25 | 1.35 |
| 7 | 1.1 | 1.45 | 1.2 | 1.35 | 23 | 1.1 | 1.2 | 1.25 | 1.17 |
| 8 | 1.1 | 1.6 | 1.2 | 1.35 | 24 | 1.1 | 1.2 | 1.22 | 1.25 |
| 9 | 1.1 | 1.35 | 1.2 | 1.3 | 25 | 1.15 | 1.2 | 1.2 | 1.32 |
| 10 | 1.6 | 1.25 | 1.2 | 1.3 | 26 | 1.15 | 1.37 | 1.2 | 1.6 |
| 11 | 1.1 | 1.2 | 1.2 | 1.2 | 27 | 1.17 | 1.35 | 1.3 | 1.82 |
| 12 | 1.15 | 1.2 | 1.2 | 1.2 | 28 | 1.3 | 1.3 | 1.3 | 1.65 |
| 13 | 1.15 | 1.2 | 1.2 | 1.2 | 29 | 1.2 | 1.35 | 1.4 | 1.5 |
| 14 | 1.15 | 1.17 | 1.2 | 1.3 | 30 | 1.2 | 1.3 | 1.3 | 1.6 |
| 15 | 1.1 | 1.2 | 1.2 | 1.3 | 31 | | 1.22 | | 1.52 |
| 16 | 1.1 | 1.22 | 1.2 | 1.32 | | | | | |

## UMPQUA RIVER DRAINAGE BASIN.

### SOUTH FORK OF UMPQUA RIVER NEAR BROCKWAY, OREG.

This station was established December 6, 1905, by L. R. Allen. It is located just below Winston's highway bridge, 3 miles east of Brockway, Oreg., and 3 miles below the mouth of Lookingglass Creek.

The channel is straight for 700 feet above and below the station. The current is uniform, somewhat broken by riffles at low water. Both banks are high, covered with brush, and not liable to overflow. The bed of the stream is of sand and gravel, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tin tag on the top of the cable support at the right bank.

The gage is a staff in two sections. The lower section is inclined; the upper section is vertical. During 1905 the gage was read once each day by George Brosi. The bench mark is the top of square-headed iron bolt driven into the downstream end of sill of the bridge at the left bank; elevation, 23.31 feet above the datum of the gage.

*Discharge measurements of South Fork of Umpqua River near Brockway, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| December 28 | L. R. Allen | 302 | 1,616 | 1.85 | 4.16 | 2,998 |

*Daily gage height, in feet, of South Fork of Umpqua River near Brockway, Oreg., for 1905.*

| Day. | Dec. | Day. | Dec. | Day. | Dec. | Day. | Dec. | Day. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 8 | 2.3 | 15 | 1.1 | 22 | 2.65 | 29 | 3.4 |
| 2 | | 9 | 2.1 | 16 | 1.05 | 23 | 2.2 | 30 | 4.35 |
| 3 | | 10 | 1.4 | 17 | 1.05 | 24 | 1.85 | 31 | 6.1 |
| 4 | | 11 | 1.4 | 18 | 1.1 | 25 | 1.1 | | |
| 5 | | 12 | 1.35 | 19 | 1.45 | 26 | 2.65 | | |
| 6 | 1.9 | 13 | 1.2 | 20 | 3.65 | 27 | 4.4 | | |
| 7 | 1.9 | 14 | 1.15 | 21 | 3.3 | 28 | 4.1 | | |

## NORTH FORK OF UMPQUA RIVER NEAR OAKCREEK, OREG.

This station was established September 6, 1905, by L. R. Allen. It is located 3 miles west of Oakcreek, Oreg., 1¼ miles above J. R. Dixon's farmhouse, about 10 miles below the mouth of East Fork of North Fork of Umpqua River.

The channel is straight for a half mile above and below the station. The current is swift. The right bank is low, covered with brush, and liable to overflow during floods. The left bank is similar, but somewhat higher, and not as apt to overflow. The bed of the stream is of gravel and rock, somewhat broken, free from vegetation, and shifting during floods. There is but one channel at all stages. Measurements may be affected by uncertainties of soundings due to the irregularities of the bed of the stream.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tag on the tagged wire, 2 feet from the cable support on the right bank.

Two gage rods were installed—one at the place of measurement and the other about 1 mile below. The lower portion of both rods is inclined, and the upper portion is vertical. During 1905 the gage was read once each day by Ethel Dixon. The bench mark at the lower gage is on top of a ¾-inch bolt, driven into sand rock about 50 feet east and 50 feet south of the gage; elevation, 28.47 feet above the datum of the gage.

*Discharge measurements of North Fork of Umpqua River near Oakcreek, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| September 6 | L. R. Allen | 215 | 457 | 1.94 | 1.35 | 886 |
| October 19 | do | 222 | 580 | 2.45 | 2.10 | 1,419 |
| December 27 | do | 279 | 1,447 | 4.91 | 5.35 | 7,110 |

*Daily gage height, in feet, of North Fork of Umpqua River near Oakcreek, Oreg., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.6 | 1.6 | 2.6 | 17 | 1.3 | 2.0 | 1.45 | 2.6 |
| 2 | ........ | 1.5 | 1.6 | 3.3 | 18 | 1.3 | 2.2 | 1.75 | 2.4 |
| 3 | ........ | 1.4 | 1.55 | 3.35 | 19 | 1.35 | 2.1 | 1.9 | 2.6 |
| 4 | ........ | 1.4 | 1.5 | 3.7 | 20 | 1.35 | 1.8 | 2.8 | 2.7 |
| 5 | ........ | 1.4 | 1.5 | 3.3 | 21 | 1.35 | 1.65 | 2.2 | 3.1 |
| 6 | 1.35 | 1.8 | 1.45 | 3.1 | 22 | 1.35 | 1.7 | 1.95 | 2.8 |
| 7 | 1.35 | 2.3 | 1.45 | 3.35 | 23 | 1.35 | 1.65 | 1.8 | 2.5 |
| 8 | 1.35 | 2.85 | 1.45 | 3.9 | 24 | 1.3 | 1.6 | 1.75 | 2.4 |
| 9 | 1.3 | 2.1 | 1.45 | 3.1 | 25 | 1.35 | 1.75 | 1.65 | 2.35 |
| 10 | 1.35 | 1.75 | 1.4 | 3.75 | 26 | 1.4 | 2.75 | 1.8 | 6.25 |
| 11 | 1.3 | 1.65 | 1.4 | 2.6 | 27 | 1.5 | 2.3 | 2.7 | 5.35 |
| 12 | 1.3 | 1.55 | 1.4 | 2.55 | 28 | 1.65 | 2.0 | 2.2 | 4.35 |
| 13 | 1.3 | 1.5 | 1.4 | 2.5 | 29 | 1.6 | 1.8 | 2.2 | 3.6 |
| 14 | 1.3 | 1.45 | 1.4 | 2.4 | 30 | 1.5 | 1.7 | 2.7 | 4.5 |
| 15 | 1.3 | 1.65 | 1.4 | 2.35 | 31 | ........ | 1.6 | ........ | 4.3 |
| 16 | 1.3 | 2.5 | 1.35 | 2.3 | | | | | |

## SILETZ RIVER DRAINAGE BASIN.

### SILETZ RIVER AT SILETZ, OREG.

This station was established November 25, 1905, by L. R. Allen. It is located at Siletz, Oreg., about 1 mile above the ferry on the Siletz and Toledo stage road, 6 miles below the mouth of Rock Creek.

The channel is straight for about 1,000 feet above and 400 feet below the station. The current is swift and rough. Both banks are high and not liable to overflow. The right bank is covered with brush; the left bank is timbered. The bed of the stream is of coarse gravel and sand, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a tin tag on the tagged wire, about 4 feet from the lower end of the turn-buckle on the right bank.

The gage is in two sections on the right bank. The lower section is inclined; the upper is vertical. During 1905 the gage was read once each day by John Kentta. The bench mark is the top of the head of a bolt driven into a large alder tree on the right bank, about 100 feet above the cable: elevation, 18.48 feet above the datum of the gage.

*Discharge measurements of Siletz River at Siletz, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Sq. ft.* | *Ft. per sec.* | *Feet.* | *Sec.-ft.* |
| November 26 | L. R. Allen | 157 | 394 | 2.95 | 2.15 | 1,167 |

*Daily gage height, in feet, of Siletz River at Siletz, Oreg., for 1905.*

| Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 3.75 | 9 | ...... | 2.9 | 17 | ...... | 7.8 | 25 | ...... | 3.2 |
| 2 | ...... | 4.2 | 10 | ...... | 2.6 | 18 | ...... | 6.0 | 26 | 2.1 | 7.5 |
| 3 | ...... | 3.8 | 11 | ...... | 2.5 | 19 | ...... | 5.3 | 27 | 2.0 | 5.2 |
| 4 | ...... | 3.3 | 12 | ...... | 2.3 | 20 | ...... | 5.6 | 28 | 2.0 | 4.3 |
| 5 | ...... | 3.0 | 13 | ...... | 2.2 | 21 | ...... | 4.9 | 29 | 2.7 | 3.8 |
| 6 | ...... | 3.7 | 14 | ...... | 2.1 | 22 | ...... | 4.0 | 30 | 3.2 | 4.3 |
| 7 | ...... | 3.3 | 15 | ...... | 2.0 | 23 | ...... | 3.9 | 31 | ...... | 5.7 |
| 8 | ...... | 3.1 | 16 | ...... | 2.2 | 24 | ...... | 3.1 | | | |

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1888. Tenth Annual Report, Part II.
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1893. Bulletin No. 131.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

# REPORT

OF

# PROGRESS OF STREAM MEASUREMENTS

FOR

# THE CALENDAR YEAR 1905

PREPARED UNDER THE DIRECTION OF F. H. NEWELL

## PART XIV.—Columbia River and Puget Sound Drainages

BY

D. W. ROSS, J. T. WHISTLER, and T. A. NOBLE

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# PROGRESS REPORT OF STREAM MEASUREMENTS FOR THE CALENDAR YEAR 1905.

## PART XIV.

By D. W. Ross, J. T. Whistler, and T. A. Noble.

## INTRODUCTION.

### ORGANIZATION AND SCOPE OF WORK.

The hydrographic work of the United States Geological Survey includes the collection of facts concerning and the study of conditions affecting the behavior of water from the time it reaches the earth as rain or snow until it joins the oceans or great navigable rivers. These investigations became a distinct feature of the work of the Survey in the fall of 1888, when an instruction camp was established at Embudo, N. Mex. The first specific appropriation for gaging streams was made by the act of August 18, 1894, which contained an item of $12,500 "for gauging the streams and determining the water supply of the United States, including the investigation of underground currents and artesian wells in the arid and semiarid sections." (28 Stat. L., p. 398.)

Since that time the appropriations have been gradually increased, as shown by the following table:

*Annual appropriation for hydrographic surveys, fiscal years ending June 30, 1895 to 1906.*

| | | | |
|---|---|---|---|
| 1895 | $12,500 | 1901 | $100,000 |
| 1896 | 20,000 | 1902 | 100,000 |
| 1897 | 50,000 | 1903 | 200,000 |
| 1898 | 50,000 | 1904 | 200,000 |
| 1899 | 50,000 | 1905 | 200,000 |
| 1900 | 50,000 | 1906 | 200,000 |

As a result of the increased appropriations the work has been greatly extended, and at the same time it has been more thoroughly sytemized by the adoption of standard methods and by grouping the States into districts, in each of which a district hydrographer and a corps of assistants carry on a comprehensive study of the hydrographic resources.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the study of the conditions affecting this flow. Information is also collected concerning river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies. This work includes the study of the hydrography of every important river basin in the United States, and is of direct value in the commercial and agricultural development of the country.

In order to collect the material from which estimates of daily flow are made, gaging stations are established. The selection of a site for a gaging station and the length of time it is maintained depend largely on the physical features and the needs of each locality. If the water is to be used for power, special effort is made to obtain information concerning the minimum flow; if water is to be stored, the maximum flow receives special attention.

In all sections of the country permanent gaging stations are maintained for general statistical purposes, to show the conditions existing through long periods. They are also used as primary stations, and their records, in connection with short series of measurements, serve as bases for estimating the flow at other points in the drainage basin.

During the calendar year 1905 the division of hydrography has continued measuring the flow of streams on the same general lines as in previous years. Many new and improved methods have been introduced, by which the accuracy and value of the results have been increased. Approximately 800 regular gaging stations were maintained during the year, and an exceptionally large number of miscellaneous measurements and special investigations were made. "The Report of Progress of Stream Measurements," which contains the results of this work, is published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 165–178, as follows:

No. 165. Atlantic coast of New England drainage.
No. 166. Hudson, Passaic, Raritan, and Delaware river drainages.
No. 167. Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.
No. 168. Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.
No. 169. Ohio and lower eastern Mississippi river drainages.
No. 170. Great Lakes and St. Lawrence River drainages.
No. 171. Hudson Bay, and upper eastern and western Mississippi River drainages.
No. 172. Missouri River drainage.
No. 173. Meramec, Arkansas, Red, and lower western Mississippi river drainages.
No. 174. Western Gulf of Mexico and Rio Grande drainages.
No. 175. Colorado River drainage.
No. 176. Great Basin drainage.
No. 177. Great Basin and Pacific Ocean drainages in California.
No. 178. Columbia River and Puget Sound drainages.

These papers embody the data collected at the regular gaging stations, the results of the computations based on the observations, and such other information as may have a direct bearing on the study of the subject, and include, as far as practicable, descriptions of the basins and the streams draining them.

For the purpose of introducing uniformity into the reports for the various years, the drainages of the United States have been divided into eleven grand divisions, which have been again divided into secondary divisions, as shown in the following list. The Progress Report has been made to conform to this arrangement, each part containing the data for one or more of the secondary divisions. The secondary divisions have in most cases been redivided, and the facts have been arranged, as far as practicable, geographically.

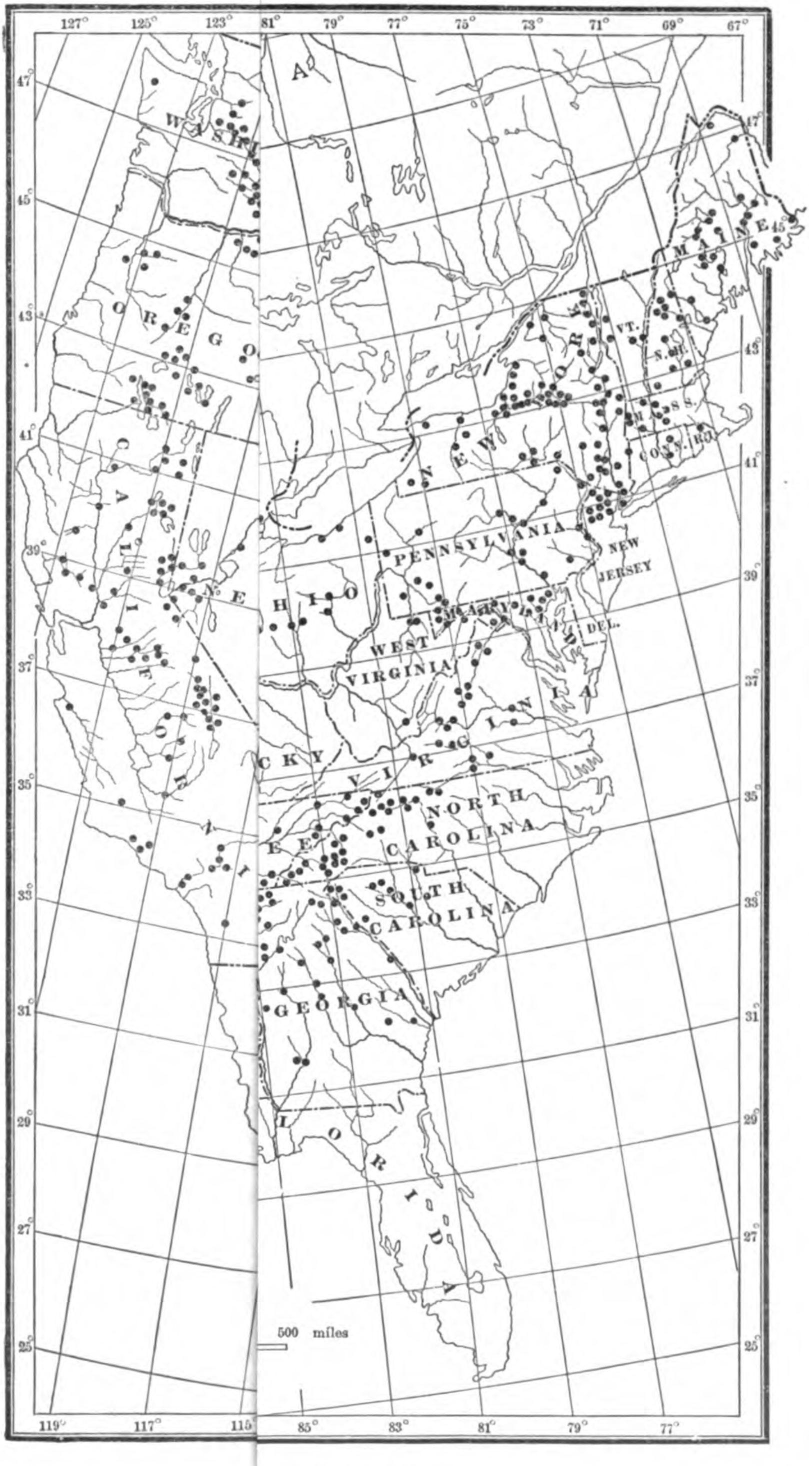
### *Drainage basins in the United States.*

#### NORTHERN ATLANTIC DRAINAGE BASINS.

St. John.
St. Croix.
Penobscot.
Kennebec.
Androscoggin.
Presumpscot.
Saco.
Merrimac.
Connecticut.
Blackstone.
Thames.
Housatonic.
Hudson.
Passaic.
Raritan.
Delaware.
Susquehanna.
Potomac.
Minor Chesapeake Bay.
Minor northern Atlantic.

#### SOUTHERN ATLANTIC DRAINAGE BASINS.

James.
Chowan.
Roanoke.
Tar.
Neuse.
Cape Fear.
Great Pedee (Yadkin).
Santee.
Savannah.
Ogeechee.
Altamaha.
Minor southern Atlantic.


127°
125°
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79°
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29°
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25°
119°
117°
115°
85°
83°
81°
79°
77°
WASH
OREGO
CALIFORNIA
NE
NEW YORK
VT.
N.H.
MAINE
MASS.
CONN.
R.I.
PENNSYLVANIA
NEW JERSEY
DEL.
MARYLAND
OHIO
WEST VIRGINIA
VIRGINIA
CKY
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
500 miles

DURING 1905.

### EASTERN GULF OF MEXICO DRAINAGE BASINS.

Suwanee.
Apalachicola.
Mobile.
Pearl.
Minor eastern Gulf of Mexico.

### EASTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Lower eastern Mississippi.
Ohio.
Upper eastern Mississippi.

### ST. LAWRENCE RIVER DRAINAGE BASINS.

Lake Superior.
Lake Michigan.
Lake Huron.
Lake St. Clair.
Lake Erie.
Niagara River.
Lake Ontario.
Lake Champlain (Richelieu River).
Minor St. Lawrence.

### WESTERN MISSISSIPPI RIVER DRAINAGE BASINS.

Upper western Mississippi.
Missouri.
Meramec.
Lower western Mississippi.
Arkansas.
Red.

### WESTERN GULF OF MEXICO DRAINAGE BASINS.

Sabine.
Neches.
Trinity.
Brazos.
Colorado (of Texas).
Guadalupe.
San Antonio.
Nueces.
Rio Grande.
Minor western Gulf of Mexico.

### COLORADO RIVER DRAINAGE BASIN.

### GREAT BASIN.

Wasatch Mountains.
Humboldt.
Sierra Nevada.
Minor streams in Great Basin.

### PACIFIC COAST DRAINAGE BASINS.

Southern Pacific.
San Francisco Bay.
Northern Pacific.
Columbia.
Puget Sound.

### HUDSON BAY DRAINAGE BASINS.

## DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups—(1) those which represent a rate of flow, as second-feet, gallons per minute, miner's inch, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second, and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water passing through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used. In most States the California miner's inch is used, which is the fiftieth part of a second-foot.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot. One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

## EXPLANATION OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of estimated monthly and yearly discharges and run-off, based on all the facts obtained to date.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station. They also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the gage height, the area of cross section, the mean velocity, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The rating table gives discharges in second-feet corresponding to each stage of the river as given by the gage heights.

In the table of estimated monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest; this is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. On this the computations for the three remaining columns, which are defined above, are based.

In the computations for the tables of this report the following general and special rules have been used:

### *Fundamental rules for computation.*

1. The highest degree of precision consistent with the rational use of time and money is imperative.

2. All items of computation should be expressed by at least two and not more than four significant figures.

3. Any measurement in a vertical velocity, mean velocity, or discharge curve whose per cent of error is five times the average per cent of error of all the other measurements should be rejected.

4. In reducing the number of significant figures, or the number of decimal places, by dropping the last figure, the following rules apply:

(a) When the figure in the place to be rejected is less than 5, drop it without changing the preceding figure. Example: 1,827.4 becomes 1,827

(b) When the figure in the place to be rejected is greater than 5, drop it and increase the preceding figure by 1. Example: 1,827.6 becomes 1,828.

(c) When the figure in the place to be rejected is 5, and it is preceded by an even figure, drop the 5. Example: 1,828.5 becomes 1,828.

(d) When the figure in the place is to be rejected is 5, and it is preceded by an odd figure, drop the 5 and increase the preceding figure by 1. Example: 1,827.5 becomes 1,828.

### *Special rules for computation.*

1. Rating tables are to be constructed as closely as the data on which they are based will warrant. No decimals are to be used when the discharge is over 50 second-feet.

2. Daily discharges shall be applied directly to the gage heights as they are tabulated.

3. Monthly means are to be carried out to one decimal place when the quantities are below 100 second-feet. Between 100 and 10,000 second-feet, the last figure in the monthly mean shall be a significant figure. This also applies to the yearly mean.

4. Second-feet per square mile and depth in inches for the individual months shall be carried out to at least three significant figures, except in the case of decimals where the first significant figure is preceded by one or more naughts (0), when the quantity shall be carried out to two significant figures. Example: 1.25; .125; .012, .0012. The yearly means for these quantities are always to be expressed in three significant figures and at least two decimal places.

## CONVENIENT EQUIVALENTS.

1 second-foot equals 50 California miner's inches.
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.
1 second-foot for one year equals 0.000214 cubic mile; equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot falling 10 feet equals 1.136 horsepower.
100 California miner's inches equal 15 United States gallons per second.
100 California miner's inches equal 77 Colorado miner's inches.
100 California miner's inches for one day equal 4 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 130 California miner's inches.
100 Colorado miner's inches for one day equal 5.2 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.44 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 inch equals 2.54 centimeters.
1 foot equals 0.3048 meter.
1 yard equals 0.9144 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 1,760 yards; equals 5,280 feet; equals 63,360 inches.
1 square yard equals 0.836 square meter.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet; equals 4,840 square yards.
1 acre equals 209 feet square, nearly.
1 square mile equals 259 hectares.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons; equals 0.804 bushel.
1 cubic foot of water weighs 62.5 pounds.
1 cubic yard equals 0.7646 cubic meter.
1 cubic mile equals 147,198,000,000 cubic feet.
1 cubic mile equals 4,667 second-feet for one year.
1 gallon equals 3.7854 liters.
1 gallon equals 8.36 pounds of water.
1 gallon equals 231 cubic inches (liquid measure).
1 pound equals 0.4536 kilogram.
1 avoirdupois pound equals 7,000 grains.
1 troy pound equals 5,760 grams.
1 meter equals 39.37 inches. Log. 1.5951654.
1 meter equals 3.280833 feet. Log. 0.5159842.
1 meter equals 1.093611 yards. Log. 0.0388629.
1 kilometer equals 3,281 feet; equals five-eighths mile, nearly.
1 square meter equals 10,764 square feet; equals 1,196 square yards.

1 hectare equals 2.471 acres.
1 cubic meter equals 35.314 cubic feet; equals 1.308 cubic yards.
1 liter equals 1.0567 quarts.
1 gram equals 15.43 grains.
1 kilogram equals 2.2046 pounds.
1 tonneau equals 2,204.6 pounds.
1 foot per second equals 1,097 kilometers per hour.
1 foot per second equals 0.68 mile per hour.
1 cubic meter per minute equals 0.5886 second-foot.
1 atmosphere equals 15 pounds per square inch; equals 1 ton per square foot; equals 1 kilogram per square centimeter.
Acceleration of gravity equals 32.16 feet per second every second.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.8 feet.
1⅓ horsepowers equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of the theoretical power.

Quick formula for computing discharge over weirs: Cubic feet per minute equals $0.4025\, l \sqrt{h^3}$; $l$ = length of weir in inches; $h$ = head in inches flowing over weir, measured from surface of still water.

To change miles to inches on map:

Scale 1: 125,000, 1 mile=0.50688 inch.
Scale 1: 90,000, 1 mile=0.70400 inch.
Scale 1: 62,500, 1 mile=1.01376 inches.
Scale 1: 45,000, 1 mile=1.40800 inches.

## FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; and (3) those with constantly shifting beds. In estimating the daily flow special methods are necessary for each class. The data on which these estimates are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; and (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

*Slope method.*—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{rs}$. This has been utilized by Kutter, both in developing his formula for $c$ and in determining the values of the coefficient $n$ which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for $n$ to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

*Weir method.*—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable estimates of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Paper No. 150); (*f*) either no flashboards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such estimates, the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the estimates of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

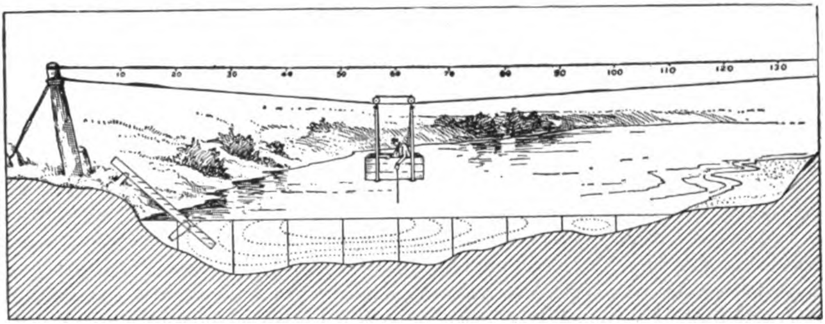

FIG. 1.—Cable station, showing section of river, car, gage, etc.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of ceofficient to be used in the weir formula and of complications in the diversion and use of the water.

*Velocity method.*—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions where the depth is over 5 feet and the bed comparatively smooth, and moreover the indications are that it will hold nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surafce, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is well adapted for measurements under ice and as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the vertical velocity-curve method and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. Such data as are available in regard to this subject are published in Water-Supply Paper No. 146, pp. 141-148.

## OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of estimating run-off, depending on whether or not the bed of the stream is permanent.

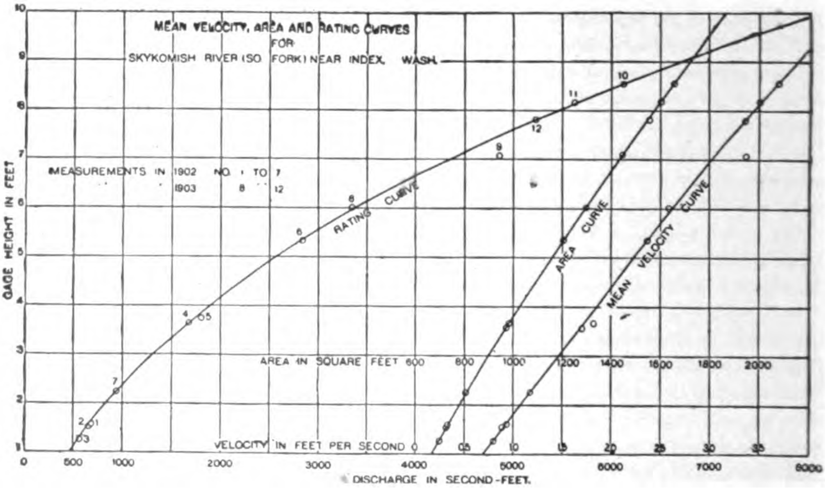

FIG. 2.—Rating, area, mean velocity, and curves for South Fork of Skykomish River near Index, Wash.

For stations on streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant; (2) the discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected; (3) the discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, estimates can be obtained by its use. In case of velocity-area stations frequent discharge measurements must be made if the estimates are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in estimating flow at stations where the bed shifts but slowly.

## COOPERATION AND ACKNOWLEDGMENTS.

Most of the measurements presented in this paper have been obtained through local hydrographers. Acknowledgment is extended to other persons and corporations who have assisted local hydrographers or have cooperated in any way, either by furnishing records of the height of water or by assisting in transportation.

The following is a list, arranged alphabetically by States, of the hydrographers and others who have assisted in furnishing and preparing the data contained in this report:

*Idaho.*—Supervising engineer, D. W. Ross,[a] assisted by L. C. LaRue, William G. Davies, and J. B. Bond. Acknowledgments and thanks are due the Oregon Short Line Railroad for transportation furnished the district engineer and his assistants.

*Montana.*—District engineer, C. C. Babb,[b] assisted by L. R. Stockman, H. M. Morse, and J. H. Sloan. Acknowledgments are due the Northern Pacific Railway for transportation furnished the hydrographers.

*Oregon.*—District engineer, John T. Whistler,[c] assisted by Wilbur C. Sawyer, E. N. Smith, Ivan Landes, and R. S. Hall. Acknowledgments and thanks are due the Oregon Railroad and Navigation Company, Southern Pacific Company, Oregon Short Line Railroad, Sumpter Valley Railway, and Columbia Southern Railway for transportation; to W. G. McDonald for the use of his ferry cable on John Day River as a gaging station, and to the Deschutes Irrigation and Power Company, Bend, Oreg., for voluntary gage readings.

*Washington.*—District engineer, T. A. Noble, assisted by W. J. Lightfoot, W. C. Muldrow, and others. Acknowledgments and thanks are due to the many owners and managers of irrigation canals in Yakima River Valley for assistance and information furnished in the prosecution of the work in that locality.

*Wyoming.*—District hydrographer, M. C. Hinderlider,[d] and resident hydrographer, A. J. Parshall. Acknowledgments are due for annual passes over all their lines in Wyoming to the Union Pacific; Chicago, Burlington and Quincy; Colorado and Southern; Colorado and Wyoming; and Fremont Elkhorn and Missouri Valley railroads.

## COLUMBIA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Next to the Colorado, Columbia River drains the largest area of all the rivers in the arid region, its drainage including parts of Washington, Oregon, Idaho, Montana, and a large area in Canada. No extensive observations of its flow have been made, but the data obtained indicate that its discharge is much greater than that of the Colorado. The Columbia and its numerous tributaries are of great importance, offering good sites for water power development and an abundance of water for irrigation, while the main river is navigable for a considerable distance.

Columbia River for most of its length in Washington and Oregon flows through a deep canyon, and can not be economically diverted for irrigation to any considerable extent, though there is one point at Priest Rapids where a very large amount of power can be economically developed and considerable land irrigated by gravity and a water-power pumping plant.

The tributaries which do not flow through deep canyons are extensively used for irrigation, and afford many opportunities for the installation of large water-power plants and extensive irrigation development in the future.

The following pages give the results of data collected in the Columbia River drainage basin during 1905.

### COLUMBIA RIVER NEAR JULIA, WASH.

This station was established by the Reclamation Service March 1, 1905, for the study of the regimen of rise and fall of Columbia River, and was discontinued October 1, 1905. It is located near Koppen's house, at Wahluke, near Julia, Wash.

The channel is straight for 4,000 feet above and 3,000 feet below the station. The current is sluggish. Both banks are high, rocky, clean, and not liable to overflow during high water.

The gage is on the north bank of the river, and is in two sections. The lower is an inclined staff, graduated to read direct to 20 feet, and the upper is a vertical staff, graduated from 20 to 24 feet. The bench mark is a spike nail driven into the base log at the southwest corner of the observer's house, 600 feet northeast of the gage; elevation, 39.52 feet above gage datum. The gage is read twice each day by Jennie C. Koppen.

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[a] Office of supervising engineer, Boise, Idaho.

[b] District office for 1906 will be at Huntley, Mont., H. M. Morse, hydrographer in charge.

[c] District office for Oregon and Washington, 1906, will be 351 Washington street, Portland, Oreg., J. C. Stevens, hydrographer in charge.

[d] Office of the district hydrographer, Chamber of Commerce Building, Denver, Colo.

*Daily gage height, in feet, of Columbia River near Julia, Wash., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 4.8 | 7.45 | 12.2 | 14.3 | 11.75 | 7.62 |
| 2 | 2.28 | 4.78 | 7.5 | 12.52 | 14.12 | 11.7 | 7.4 |
| 3 | 2.22 | 4.77 | 7.58 | 13.12 | 14.0 | 11.62 | 7.22 |
| 4 | 2.42 | 4.7 | 7.6 | 13.7 | 13.92 | 11.52 | 7.12 |
| 5 | 2.58 | 4.7 | 7.6 | 14.05 | 13.88 | 11.45 | 6.95 |
| 6 | 2.7 | 4.65 | 7.68 | 14.08 | 13.82 | 11.45 | 6.78 |
| 7 | 2.88 | 4.6 | 7.8 | 14.88 | 13.72 | 11.4 | 6.62 |
| 8 | 3.0 | 4.65 | 7.95 | 15.15 | 13.55 | 11.35 | 6.5 |
| 9 | 3.15 | 4.7 | 8.18 | 15.55 | 13.4 | 11.3 | 6.38 |
| 10 | 3.32 | 4.7 | 8.48 | 15.98 | 13.3 | 11.25 | 6.35 |
| 11 | 3.52 | 4.75 | 8.7 | 16.28 | 13.25 | 11.2 | 6.28 |
| 12 | 3.8 | 4.75 | 9.0 | 16.48 | 13.2 | 11.15 | 6.18 |
| 13 | 3.8 | 4.75 | 9.0 | 16.55 | 13.15 | 11.0 | 6.15 |
| 14 | 3.88 | 4.82 | 9.1 | 16.72 | 13.1 | 11.98 | 6.15 |
| 15 | 3.9 | 4.88 | 9.2 | 16.85 | 13.02 | 10.88 | 6.13 |
| 16 | 3.98 | 4.92 | 9.35 | 16.9 | 12.92 | 10.88 | 6.08 |
| 17 | 3.96 | 4.98 | 9.48 | 16.75 | 12.88 | 10.78 | 6.0 |
| 18 | 3.98 | 5.0 | 9.68 | 16.4 | 12.78 | 10.62 | 5.98 |
| 19 | 4.0 | 5.0 | 9.92 | 16.28 | 12.68 | 10.45 | 5.88 |
| 20 | 4.12 | 5.08 | 10.1 | 16.15 | 12.5 | 10.15 | 5.82 |
| 21 | 4.4 | 5.18 | 10.08 | 15.85 | 12.25 | 9.9 | 5.75 |
| 22 | 4.45 | 5.35 | 10.12 | 15.65 | 12.12 | 9.65 | 5.75 |
| 23 | 4.6 | 5.55 | 10.35 | 15.48 | 11.98 | 9.45 | 5.7 |
| 24 | 4.7 | 5.9 | 10.42 | 15.4 | 11.92 | 9.2 | 5.65 |
| 25 | 4.75 | 6.52 | 10.5 | 15.32 | 11.88 | 8.98 | 5.65 |
| 26 | 4.7 | 6.78 | 10.75 | 15.22 | 11.78 | 8.68 | 5.65 |
| 27 | 4.77 | 7.05 | 10.92 | 15.1 | 11.78 | 8.45 | 5.68 |
| 28 | 4.75 | 7.42 | 11.2 | 14.8 | 11.73 | 8.25 | 5.78 |
| 29 | 4.8 | 7.6 | 11.48 | 14.68 | 11.75 | 8.05 | 5.95 |
| 30 | 4.8 | 7.5 | 11.75 | 14.5 | 11.75 | 7.85 | 6.12 |
| 31 | 4.77 | ........ | 11.95 | ........ | 11.75 | 7.73 | ........ |

## COLUMBIA RIVER NEAR PASCO, WASH.

This station was established October 15, 1904, by C. B. Cox. It is located at the bridge of the Northern Pacific Railway 1.2 miles from Pasco, Wash.

The channel is curved for about 800 feet above and straight for about one-fourth mile below the station. The water above the station is smooth. It becomes swift and rough on the west side of the channel 600 feet below the station. Both banks overflow during high water. The bed of the stream is composed of bowlders, and is fairly permanent. There is one channel at high and two at very low stages. The piers of the bridge, a bar 600 feet below the station, and the movements of the boat affect the measurements.

Discharge measurements are made by means of a boat held from the bridge by a one-fourth inch rope cable 400 feet long. The meter is lowered 2 feet above the bow of the boat, over a roller on a projecting plank, and is controlled by a windlass. The initial point for soundings is 400 feet below the railway bridge, opposite the center of the east pier.

A staff gage in two sections, graduated to feet and tenths, is bolted vertically to the third pier from the east end of the bridge. The lower section is graduated from zero to 10 feet. The upper section is graduated from zero to 20 feet, with its zero at the 10-foot mark of the lower section. Gage readings have been reduced to the zero of the lower section. The gage is read once each day by W. B. Sloan. A United States Geological Survey standard aluminum bench-mark tablet marked "350" is placed on the south side of the first pier from the east end of the bridge; elevation, 349.78 feet above sea level and

42.03 feet above gage datum. A United States Coast and Geodetic Survey brass bench-mark tablet on the same pier has an elevation of 44.51 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135 of the United States Geological Survey, pages 24-25.

*Daily gage height, in feet, of Columbia River near Pasco, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.7 | 7.6 | 7.9 | 10.9 | 14.1 | 18.8 | 20.5 | 16.9 | 12.7 | 11.2 | 10.4 | 8.9 |
| 2 | 7.8 | 7.4 | 8.0 | 10.9 | 13.9 | 19.4 | 20.3 | 16.9 | 12.5 | 11.3 | 10.3 | 8.9 |
| 3 | 7.8 | 7.3 | 8.1 | 10.8 | 13.8 | 20.0 | 20.1 | 16.9 | 12.3 | 11.3 | 10.2 | 8.9 |
| 4 | 7.8 | 7.3 | 8.4 | 10.8 | 13.9 | 20.7 | 20.0 | 16.8 | 12.2 | 11.5 | 10.1 | 8.8 |
| 5 | 7.7 | 7.2 | 8.7 | 10.7 | 13.9 | 21.2 | 19.8 | 16.7 | 12.0 | 11.8 | 10.0 | 8.7 |
| 6 | 7.7 | 7.2 | 9.0 | 10.6 | 14.0 | 21.6 | 19.6 | 16.6 | 11.9 | 11.9 | 10.0 | 8.7 |
| 7 | 7.6 | 7.0 | 9.2 | 10.5 | 14.0 | 21.9 | 19.4 | 16.6 | 11.7 | 12.1 | 9.9 | 8.6 |
| 8 | 7.6 | 6.8 | 9.3 | 10.5 | 14.0 | 22.1 | 19.2 | 16.6 | 11.6 | 12.2 | 9.8 | 8.6 |
| 9 | 7.6 | 6.8 | 9.5 | 10.7 | 14.2 | 22.4 | 19.1 | 16.6 | 11.3 | 12.3 | 9.7 | 8.6 |
| 10 | 7.5 | 6.9 | 9.6 | 10.8 | 14.7 | 22.8 | 19.1 | 16.5 | 11.3 | 12.4 | 9.6 | 8.6 |
| 11 | 7.4 | 7.0 | 9.8 | 11.0 | 15.3 | 23.0 | 19.0 | 16.4 | 11.2 | 12.3 | 9.5 | 8.5 |
| 12 | 7.3 | 6.7 | 10.0 | 10.9 | 15.5 | 23.2 | 19.0 | 16.3 | 11.2 | 12.1 | 9.5 | 8.4 |
| 13 | 7.3 | 6.4 | 10.2 | 10.9 | 15.6 | 23.3 | 18.9 | 16.2 | 11.2 | 12.1 | 9.5 | 8.3 |
| 14 | 7.2 | 6.5 | 10.2 | 10.9 | 15.6 | 23.4 | 18.9 | 16.1 | 11.1 | 12.0 | 9.4 | 8.2 |
| 15 | 7.1 | 6.3 | 10.2 | 10.9 | 15.6 | 23.4 | 18.9 | 16.0 | 11.1 | 11.9 | 9.3 | 8.2 |
| 16 | 7.0 | 6.2 | 10.3 | 10.9 | 15.6 | 23.3 | 18.5 | 15.9 | 11.0 | 11.8 | 9.2 | 8.2 |
| 17 | 6.9 | 6.4 | 10.2 | 10.9 | 15.6 | 23.0 | 18.4 | 15.8 | 11.0 | 11.7 | 9.2 | 8.1 |
| 18 | 6.8 | 6.5 | 10.2 | 11.0 | 15.8 | 22.9 | 18.2 | 15.7 | 10.9 | 11.5 | 9.1 | 8.1 |
| 19 | 6.9 | 6.6 | 10.4 | 11.1 | 16.1 | 22.6 | 18.1 | 15.6 | 10.9 | 11.3 | 9.1 | 8.1 |
| 20 | 7.0 | 6.7 | 10.5 | 11.2 | 16.3 | 22.4 | 18.0 | 15.1 | 10.9 | 11.1 | 9.0 | 8.1 |
| 21 | 7.0 | 6.7 | 10.6 | 11.4 | 16.6 | 22.2 | 17.9 | 15.0 | 10.8 | 11.2 | 9.0 | 8.0 |
| 22 | 7.1 | 6.8 | 10.7 | 11.7 | 16.8 | 22.0 | 17.5 | 14.9 | 10.8 | 11.1 | 9.0 | 8.0 |
| 23 | 7.1 | 7.2 | 10.8 | 12.0 | 16.9 | 22.8 | 17.3 | 14.6 | 10.7 | 11.0 | 9.0 | 8.0 |
| 24 | 7.2 | 7.4 | 10.8 | 12.3 | 16.9 | 21.6 | 17.1 | 14.3 | 10.6 | 10.9 | 9.0 | 7.9 |
| 25 | 7.3 | 7.4 | 10.9 | 12.6 | 16.9 | 21.5 | 17.0 | 13.9 | 10.6 | 10.7 | 9.0 | 7.9 |
| 26 | 7.5 | 7.5 | 10.9 | 13.2 | 16.9 | 21.4 | 16.9 | 13.8 | 10.5 | 10.7 | 8.9 | 7.8 |
| 27 | 7.7 | 7.7 | 11.0 | 13.8 | 16.9 | 21.3 | 16.9 | 13.6 | 10.7 | 10.7 | 8.9 | 7.8 |
| 28 | 7.7 | 7.8 | 11.0 | 14.3 | 17.0 | 21.0 | 16.9 | 13.4 | 10.8 | 10.8 | 8.9 | 7.8 |
| 29 | 7.7 | ....... | 11.0 | 14.4 | 17.5 | 20.8 | 16.9 | 13.2 | 10.9 | 10.8 | 8.9 | 7.8 |
| 30 | 7.8 | ....... | 11.0 | 14.3 | 17.9 | 20.7 | 16.9 | 13.0 | 10.9 | 10.7 | 8.9 | 7.7 |
| 31 | 7.7 | ....... | 10.9 | ....... | 18.3 | ....... | 16.9 | 12.9 | ....... | 10.6 | ....... | 7.7 |

NOTE.—No ice record.

## CLARK FORK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Clark Fork of the Columbia has its source in Silverbow County, Mont., and flows northward until it receives the waters of Little Blackfoot River, when it takes a more northwesterly course. The name Missoula is usually applied to that portion of the river between the junction of Big Blackfoot and Hellgate rivers and the mouth of Flathead River. From that point to its junction with Columbia River it is called Clark Fork of the Columbia.

The source of Bitterroot River is in the high mountains which form the boundary line between Montana and Idaho. It flows in a northerly direction, entering Missoula River a short distance below the city of Missoula. The tributaries on the east side drain comparatively low hills and contribute little to the supply of the river. The west-side branches, on the contrary, are numerous, draining a precipitous and heavily wooded area. Their discharge is regulated by many small lakes, fed by banks of snow, which continue far into summer before disappearing altogether. From Hamilton to Missoula, a distance of 48 miles, the fall of the river is 350 feet, or 7.3 feet to the mile.

## CLARK FORK[a] AT PRIEST RIVER, IDAHO.

This station was established in June, 1903, by T. A. Noble, and was discontinued April 30, 1905. It is located on the right bank of the river, about 1,000 feet west of Priest River railroad station.

The channel is straight for about 2,000 feet above and below the station. The right bank is high, covered with underbrush, and not subject to overflow. The left bank is low, cleared, and liable to overflow. From the top of the left bank there is an upward slope of about 10 per cent. The water flows in one channel, and the bed of the stream is composed of sand, with occasional bowlders.

Discharge measurements were made from a ferry cable, which is at a right angle to the stream. The initial point for soundings is a stake on the left bank of the stream and the west side of the driveway. Its elevation is 2,062.11 feet above sea level. On the right bank, 1,020 feet from the initial point, is another stake, with a tack in its head. Its elevation above sea level is 2,076.31 feet.

A wire gage is fastened to the railing of the platform, which is built between four trees. The bench marks are as follows: (1) A United States Geological Survey bench mark south of Priest River station, at the northeast corner of the hotel, from which all elevations were obtained; elevation, 2,077.00 feet; (2) a bench mark under the gage-board platform; elevation, 2,066.19 feet; (3) a bench mark on a stump near the gage; elevation, 2,073.02 feet. Elevations refer to sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp. 399–400; 135, pp. 40–41.
Discharge: 100, p. 400; 135, p. 41.
Discharge, monthly: 135, p. 43.
Gage heights: 100, pp. 400–401; 135, pp. 41–42.
Rating table: 135, p. 42.

*Discharge measurements of Clark Fork at Priest River, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 19 | Laurgaard and Costeel | 715 | 3,896 | 2.02 | 42.52 | 7,852 |
| February 3[a] | C. Costeel | 704 | 3,498 | 1.55 | 41.85 | 5,419 |

[a] Ice conditions.

*Daily gage height, in feet, of Clark Fork at Priest River, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 42.68 | 42.15 | 42.72 | 43.78 | 17 | 42.42 | 42.31 | 43.2 | 43.9 |
| 2 | 42.67 | 41.3 | 42.78 | 43.75 | 18 | 42.5 | 42.3 | 43.28 | 43.9 |
| 3 | 42.72 | 41.85 | 42.8 | 43.74 | 19 | 42.52 | 42.29 | 43.31 | 43.92 |
| 4 | 42.68 | 42.22 | 42.88 | 43.8 | 20 | 42.55 | 42.32 | 43.33 | 43.92 |
| 5 | 42.7 | 42.34 | 42.9 | 43.75 | 21 | 42.57 | 42.41 | 43.35 | 43.95 |
| 6 | 42.60 | 42.4 | 42.92 | 43.69 | 22 | 42.59 | 42.42 | 43.45 | 44.01 |
| 7 | 42.8 | 42.49 | 43.0 | 43.68 | 23 | 42.6 | 42.48 | 43.5 | 44.1 |
| 8 | 42.71 | 42.45 | 43.05 | 43.68 | 24 | 42.62 | 42.52 | 43.52 | 44.19 |
| 9 | 42.62 | 42.5 | 43.09 | 43.77 | 25 | 42.65 | 42.55 | 43.6 | 44.35 |
| 10 | 42.62 | 42.75 | 43.19 | 43.7 | 26 | 42.62 | 42.6 | 43.55 | 44.27 |
| 11 | 42.54 | 41.69 | 43.35 | 43.71 | 27 | 42.68 | 42.64 | 43.63 | 44.55 |
| 12 | 41.59 | 42.0 | 43.39 | 43.77 | 28 | 42.7 | 42.69 | 43.7 | 44.75 |
| 13 | 41.12 | 42.12 | 43.32 | 43.9 | 29 | 42.73 | ........ | 43.71 | 44.9 |
| 14 | 41.24 | 42.29 | 43.15 | 43.85 | 30 | 42.71 | ........ | 43.73 | 45.01 |
| 15 | 42.04 | 42.28 | 43.19 | 43.85 | 31 | 42.8 | ........ | 43.77 | ........ |
| 16 | 42.32 | 42.3 | 43.19 | 43.89 | | | | | |

**Note.**—No ice record.

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[a] Formerly called Pend Oreille River.

*Station rating table for Clark Fork at Priest River, Idaho, from June 26, 1903, to April 30, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 41.10 | 5,680 | 42.20 | 6,990 | 43.20 | 9,740 | 44.20 | 13,470 |
| 41.20 | 5,770 | 42.30 | 7,220 | 43.30 | 10,070 | 44.30 | 13,890 |
| 41.30 | 5,865 | 42.40 | 7,460 | 43.40 | 10,410 | 44.40 | 14,320 |
| 41.40 | 5,960 | 42.50 | 7,700 | 43.50 | 10,750 | 44.50 | 14,760 |
| 41.50 | 6,055 | 42.60 | 7,960 | 43.60 | 11,110 | 44.60 | 15,200 |
| 41.60 | 6,150 | 42.70 | 8,230 | 43.70 | 11,480 | 44.70 | 15,650 |
| 41.70 | 6,250 | 42.80 | 8,510 | 43.80 | 11,860 | 44.80 | 16,110 |
| 41.80 | 6,350 | 42.90 | 8,810 | 43.90 | 12,250 | 44.90 | 16,570 |
| 41.90 | 6,450 | 43.00 | 9,110 | 44.00 | 12,650 | 45.00 | 17,050 |
| 42.00 | 6,550 | 43.10 | 9,420 | 44.10 | 13,050 | 45.90 | 21,530 |
| 42.10 | 6,770 | | | | | | |

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined above gage height 42.5 feet.

*Estimated monthly discharge of Clark Fork at Priest River, Idaho, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 8,510 | 5,698 | 7,791 | 479,000 |
| February | 8,370 | 5,865 | 7,316 | 406,300 |
| March | 11,750 | 8,286 | 10,030 | 616,700 |
| April | 17,100 | 11,400 | 12,700 | 755,700 |

## MISSOULA RIVER AT MISSOULA, MONT.

This station was established July 10, 1898, at Higgins Avenue Bridge, Missoula, Mont. Because of fluctuations in the water surface, the station was removed May 27, 1899, to the bridge of the Bitterroot Valley division of the Northern Pacific Railway, about one-half mile downstream.

Both banks are high at this point. The water is deep and the current exceedingly swift during high water. At lower stages it is comparatively sluggish. The stream bed is probably shifting.

Ordinarily there is but one channel, broken only by two large crib piers, but in time of flood some water passes through a slough 600 feet south of the bridge. The channel is considerably obstructed by rip rap and remains of old cribs and piers.

Discharge measurements are made from the downstream side of the railway bridge. The initial point for soundings is at the right end over the northwest abutment, opposite the center of the first angle block of the truss.

A standard chain gage is attached to a horizontal timber bolted to a cottonwood tree on the right bank 400 feet above the bridge; length of chain, 21.94 feet. During 1905 the gage was read twice each day by Thomas E. Westby. The bench mark is a United States Geological Survey standard iron post on the north side of Front street, about 200 feet west of McCormick street; elevation, 3,194.64 feet above sea level (Missoula datum) and 32.46 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 20, iv, pp 490-491; 21, iv, p 418; WS 28, pp 156-157; 38, pp 364-365; 51, p 432; 66, p 131; 85, p 199; 100, p 403; 135, pp 28-29.

Discharge: WS 28, p 169; 38, p 365; 51, p 432; 66, p 131; 85, p 199; 100, p 403; 135, p 29.

Discharge, monthly: Ann 20, iv, p 491; 21, iv, p 418; 22, iv, p 435; WS 75, p 198; 85, p 201; 100, p 405; 135, p 31.

**Discharge, yearly:** Ann 20, iv, p 63.
**Gage heights:** WS 28, p 163; 38, pp 366-367; 51, p 433; 66, p 131; 85, p 200; 100, p 404; 135, p 30.
**Hydrographs:** Ann 21, iv, p 419; 22, iv, p 435; WS 75, p 199.
**Rating tables:** WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 85, p 200; 100, p 405; 135, p 31.

*Discharge measurements of Missoula River at Missoula, Mont., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 17 | L. R. Stockman | 163 | 757 | 1.74 | 3.16 | 1,320 |
| May 5 | J. H. Sloan | 169 | 860 | 2.05 | 3.50 | 1,766 |
| May 22 | do | 184 | 1,015 | 3.89 | 4.66 | 3,950 |
| June 16 | do | 283 | 1,236 | 4.06 | 5.44 | 5,016 |
| July 10 | do | 170 | 918 | 2.52 | 4.00 | 2,310 |
| August 11 | do | 163 | 778 | 1.52 | 3.00 | 1,181 |
| September 5 | do | 158 | 665 | 1.34 | 2.56 | 888 |
| October 3 | do | 154 | 673 | 1.35 | 2.67 | 907 |
| October 24 | Morse and Sloan | 164 | 764 | 1.65 | 2.95 | 1,221 |

*Daily gage height, in feet, of Missoula River at Missoula, Mont., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 2.65 | 3.7 | 3.1 | 3.5 | 5.3 | 5.02 | 3.38 | 2.58 | 2.65 | 2.78 | 2.9 |
| 2 | ....... | 2.65 | 3.45 | 3.1 | 3.5 | 5.48 | 4.95 | 3.3 | 2.55 | 2.65 | 3.0 | 2.95 |
| 3 | ....... | 2.65 | 3.38 | 3.1 | 3.5 | 5.72 | 4.9 | 3.3 | 2.55 | 2.75 | 2.95 | 2.95 |
| 4 | ....... | 2.65 | 3.42 | 3.1 | 3.45 | 5.75 | 4.78 | 3.3 | 2.55 | 2.75 | 2.95 | 2.95 |
| 5 | ....... | 2.7 | 3.4 | 3.05 | 3.45 | 5.8 | 4.7 | 3.25 | 2.55 | 2.75 | 2.98 | 2.95 |
| 6 | ....... | 2.85 | 3.4 | 3.08 | 3.35 | 5.92 | 4.55 | 3.2 | 2.52 | 2.7 | 3.0 | 2.92 |
| 7 | 2.75 | 2.92 | 3.35 | 3.15 | 3.35 | 6.16 | 4.35 | 3.12 | 2.45 | 2.7 | 3.0 | 2.9 |
| 8 | ....... | 3.0 | 3.32 | 3.2 | 3.42 | 6.45 | 4.22 | 3.08 | 2.45 | 2.75 | 3.0 | 2.92 |
| 9 | ....... | 3.02 | 3.25 | 3.2 | 3.8 | 6.4 | 4.12 | 3.02 | 2.42 | 2.82 | 2.98 | 2.95 |
| 10 | ....... | 3.05 | 3.15 | 3.2 | 4.1 | 6.35 | 4.05 | 3.0 | 2.55 | 2.8 | 2.95 | 2.95 |
| 11 | ....... | 3.1 | 3.02 | 3.12 | 4.05 | 6.18 | 3.98 | 3.0 | 2.55 | 2.8 | 2.95 | 2.95 |
| 12 | ....... | 3.1 | 2.95 | 3.1 | 4.05 | 6.05 | 3.85 | 2.95 | 2.55 | 2.8 | 2.95 | 2.95 |
| 13 | ....... | 3.05 | 2.95 | 3.18 | 4.0 | 5.95 | 3.8 | 2.9 | 2.52 | 2.8 | 2.95 | 2.95 |
| 14 | 3.8 | 3.05 | 3.05 | 3.25 | 3.95 | 5.95 | 3.7 | 2.88 | 2.5 | 2.75 | 2.95 | 2.95 |
| 15 | ....... | 3.05 | 3.18 | 3.2 | 3.95 | 5.7 | 3.62 | 2.85 | 2.5 | 2.8 | 2.9 | 2.95 |
| 16 | ....... | 3.1 | 3.25 | 3.12 | 3.9 | 5.48 | 3.55 | 2.85 | 2.5 | 2.8 | 2.85 | 2.95 |
| 17 | ....... | 3.1 | 3.25 | 3.1 | 4.0 | 4.92 | 3.5 | 2.9 | 2.5 | 2.8 | 2.85 | 2.95 |
| 18 | ....... | 3.1 | 3.25 | 3.15 | 4.22 | 5.12 | 3.5 | 2.95 | 2.5 | 2.85 | 2.85 | 2.95 |
| 19 | ....... | 3.15 | 3.25 | 3.18 | 4.38 | 4.92 | 3.5 | 2.88 | 2.5 | 2.85 | 2.85 | 2.98 |
| 20 | ....... | 3.25 | 3.25 | 3.32 | 4.5 | 4.8 | 3.42 | 2.82 | 2.5 | 2.85 | 2.9 | 3.0 |
| 21 | 3.6 | 3.2 | 3.2 | 3.3 | 4.6 | 4.7 | 3.35 | 2.8 | 2.55 | 2.9 | 2.95 | 3.0 |
| 22 | ....... | 3.3 | 3.2 | 3.3 | 4.78 | 4.52 | 3.32 | 2.78 | 2.55 | 2.95 | 2.95 | 3.0 |
| 23 | ....... | 3.38 | 3.2 | 3.35 | 4.7 | 4.75 | 3.28 | 2.62 | 2.55 | ....... | 2.95 | 3.0 |
| 24 | ....... | 3.52 | 3.15 | 3.42 | 4.68 | 4.98 | 3.25 | 2.65 | 2.5 | ....... | 2.95 | 3.0 |
| 25 | ....... | 3.6 | 3.1 | 3.5 | 4.48 | 5.05 | 3.22 | 2.65 | 2.5 | ....... | 2.95 | 3.1 |
| 26 | 3.3 | 3.75 | 3.1 | 3.58 | 4.38 | 5.05 | 3.2 | 2.65 | 2.5 | 3.1 | 2.95 | 3.1 |
| 27 | 3.2 | 4.0 | 3.1 | 3.6 | 4.4 | 5.68 | 3.28 | 2.65 | 2.52 | 3.05 | 2.92 | 3.1 |
| 28 | 3.25 | 3.92 | 3.15 | 3.58 | 4.42 | 5.55 | 3.35 | 2.65 | 2.6 | 3.0 | 2.9 | 3.1 |
| 29 | 3.2 | ....... | 3.15 | 3.5 | 4.5 | 5.38 | 3.35 | 2.65 | 2.6 | 3.0 | 2.85 | 3.1 |
| 30 | 3.28 | ....... | 3.12 | 3.5 | 4.5 | 5.2 | 3.65 | 2.65 | 2.65 | 2.95 | 2.7 | 3.15 |
| 31 | 3.3 | ....... | 3.1 | ....... | 4.98 | ....... | 3.42 | 2.6 | ....... | 2.88 | ....... | 3.15 |

NOTE.—River frozen during January and February, March 12-13, and November 24 to December 31; readings are to top of ice.

*Station rating table for Missoula River at Missoula, Mont., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.40 | 735 | 3.30 | 1,485 | 4.20 | 2,570 | 5.00 | 4,050 |
| 2.50 | 800 | 3.40 | 1,590 | 4.30 | 2,720 | 5.20 | 4,510 |
| 2.60 | 870 | 3.50 | 1,700 | 4.40 | 2,880 | 5.40 | 5,000 |
| 2.70 | 945 | 3.60 | 1,810 | 4.50 | 3,050 | 5.60 | 5,530 |
| 2.80 | 1,025 | 3.70 | 1,930 | 4.60 | 3,230 | 5.80 | 6,100 |
| 2.90 | 1,110 | 3.80 | 2,050 | 4 70 | 3,420 | 6.00 | 6,710 |
| 3.00 | 1,200 | 3.90 | 2,170 | 4.80 | 3,620 | 6.20 | 7,370 |
| 3.10 | 1,290 | 4.00 | 2,300 | 4.90 | 3,830 | 6.40 | 8,110 |
| 3.20 | 1,385 | 4.10 | 2,430 | | | | |

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1904-5. It is fairly well defined throughout.

*Estimated monthly discharge of Missoula River at Missoula, Mont., for 1905.*

[Drainage area, 5,960 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 1-11, 14-31 | 1,930 | 1,218 | 1,427 | 82,080 | 0.239 | 0.258 |
| April | 1,810 | 1,245 | 1,442 | 85,800 | .242 | .270 |
| May | 4,006 | 1,538 | 2,497 | 153,500 | .419 | .483 |
| June | 8,310 | 3,086 | 5,429 | 323,000 | .911 | 1.02 |
| July | 4,096 | 1,385 | 2,182 | 134,200 | .366 | .422 |
| August | 1,569 | 870 | 1,132 | 69,600 | .190 | .219 |
| September | 908 | 748 | 819 | 48,730 | .137 | .153 |
| October | 1,290 | 908 | 1,069 | 65,730 | .179 | .206 |
| November 1-23 | 1,200 | 1,009 | 1,140 | 52,000 | .191 | .163 |
| The period | | | | 1,015,000 | | |

NOTE.—No estimate for ice period.

## BIG BLACKFOOT RIVER NEAR BONNER, MONT.

This station was established in July, 1898. It is situated a short distance above the junction of Big Blackfoot with Hellgate River, at the county highway bridge, one-half mile west of Bonner and 6 miles east of Missoula. The station was abandoned October 31, 1905, because of a dam which was being erected in Hellgate River just below the mouth of the Big Blackfoot.

The power dam of the Big Blackfoot Milling Company, about 1,000 yards above the station, interferes with the natural flow of the water, the opening and closing of the gates causing abrupt changes in river height. The channel at the station is straight for some distance. Both banks are high and rocky and are covered with brush and trees. Neither bank is subject to overflow. The bed of the stream is rocky and covered with cobble and bowlders. It is not liable to change. The depth of the water varies from 4 to 10 feet. The current is very swift and a stay line is necessary for the meter at all but the lowest stages.

Discharge measurements are made from the lower side of the bridge, the initial point for soundings being at the left bank.

A standard chain gage is attached to the downstream guard rail of the bridge; length of chain, 20.68 feet. During 1905 the gage was read twice each day by Charles Anderson. Bench marks were established as follows: (1) A temporary bench mark of the topographic division of the United States Geological Survey, consisting of a cross cut in the northeast corner of the top of the northeast abutment of the Northern Pacific Railway bridge near Bonner; elevation, 3,290.30 feet above sea level. (2) A standard United States Geological Survey iron post located in front of John McCormick's house just east of the highway bridge; elevation, 3,246.04 feet above sea level. The zero of the gage is 3,230.70 feet above sea level. All elevations refer to the Missoula datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

**Description:** Ann 20, iv, p 491; WS 28, pp 155-156; 38, p 362; 51, p 430; 66, p 130; 100, pp 410-411; 135, p 32.
**Discharge:** WS 28, p 168; 38, p 362; 51, p 430; 66, p 130; 85, p 216; 100, p 411; 135, p 33.
**Discharge, monthly:** Ann 20, iv, p 491; 21, iv, p 416; 22, iv, p 433; WS 75, p 198; 100, p 413; 135, p 34.
**Discharge, yearly:** Ann 20, iv, p 62.
**Gage heights:** WS 28, p 163; 38, p 363; 51, p 431; 66, p 130; 100, pp 411-412; 135, p 33.
**Hydrographs:** Ann 21, iv, p 416; 22, iv, p 434.
**Rating tables:** WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 100, p 412; 135, p 34.

*Discharge measurements of Big Blackfoot River near Bonner, Mont., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 17 | L. R. Stockman | 120 | 428 | 1.14 | 0.30 | 486 |
| May 5 | J. H. Sloan | 120 | 445 | 1.55 | .46 | 690 |
| May 22 | .....do | 127 | 614 | 3.15 | 2.04 | 1,936 |
| June 16 | .....do | 133 | 677 | 4.07 | 2.80 | 2,754 |
| July 10 | .....do | 125 | 565 | 2.26 | 1.32 | 1,278 |
| August 10 | .....do | 121 | 460 | 1.46 | .60 | 673 |
| September 5 | .....do | 119 | 405 | 1.06 | .36 | 432 |
| October 3 | .....do | 119 | 405 | 1.08 | .35 | 438 |
| October 24 | Morse and Sloan | 118 | 415 | 1.02 | .21 | 425 |

*Daily gage height, in feet, of Big Blackfoot River near Bonner, Mont., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.75 | 2.3 | 1.0 | 0.2 | 0.7 | 2.8 | 1.9 | 0.7 | 0.3 | 0.3 |
| 2 | .6 | 1.95 | .7 | .2 | .8 | 3.05 | 1.8 | .75 | .25 | .4 |
| 3 | .45 | 1.85 | .55 | .25 | .75 | 3.25 | 1.8 | .75 | .25 | .35 |
| 4 | .4 | 2.2 | .45 | .25 | .8 | 3.4 | 1.7 | .7 | .3 | .3 |
| 5 | .25 | 2.1 | .45 | .15 | .7 | 3.55 | 1.6 | .7 | .25 | .25 |
| 6 | .3 | 2.2 | .45 | .2 | .7 | 3.85 | 1.55 | .7 | .25 | .3 |
| 7 | .45 | 2.1 | .35 | .25 | .75 | 3.8 | 1.5 | .65 | .25 | .3 |
| 8 | .6 | 2.2 | .35 | .25 | .8 | 3.75 | 1.4 | .6 | .25 | .25 |
| 9 | 1.2 | 2.4 | .3 | .25 | 1.0 | 3.85 | 1.35 | .6 | .1 | .35 |
| 10 | .75 | 2.35 | .35 | .25 | 1.35 | 3.75 | 1.3 | .6 | .15 | .3 |
| 11 | .7 | 2.35 | .25 | .25 | 1.3 | 3.5 | 1.25 | .6 | .15 | .4 |
| 12 | ........ | 2.05 | .05 | .25 | 1.3 | 3.3 | 1.2 | .5 | .15 | .4 |
| 13 | ........ | 2.5 | .2 | .25 | 1.3 | 3.35 | 1.15 | .5 | .2 | .3 |
| 14 | ........ | 2.6 | .25 | .2 | 1.25 | 3.25 | 1.1 | .5 | .25 | .4 |
| 15 | ........ | 2.8 | .25 | .25 | 1.2 | 3.0 | 1.05 | .5 | .25 | .35 |
| 16 | ........ | 2.6 | .2 | .2 | 1.2 | 2.8 | 1.0 | .5 | .15 | .45 |
| 17 | ........ | 2.65 | .25 | .22 | 1.2 | 2.6 | 1.0 | .5 | .2 | .35 |
| 18 | ........ | 2.4 | .25 | .3 | 1.45 | 2.5 | 1.0 | .5 | .2 | .5 |
| 19 | ........ | 2.3 | .2 | .25 | 1.65 | 2.4 | 1.0 | .5 | .25 | .4 |
| 20 | ........ | 2.35 | .3 | .3 | 1.75 | 2.25 | .9 | .5 | .2 | .45 |
| 21 | ........ | 2.15 | .35 | .3 | 1.85 | 2.1 | .9 | .4 | .15 | .4 |
| 22 | ........ | 2.25 | .3 | .3 | 2.0 | 2.1 | .9 | .4 | .15 | .15 |
| 23 | ........ | 2.05 | .25 | .3 | 1.85 | 2.2 | .8 | .4 | .15 | .3 |
| 24 | ........ | 1.6 | .2 | .35 | 1.75 | 2.2 | .8 | .3 | .15 | .4 |
| 25 | ........ | 1.4 | .2 | .4 | 1.65 | 2.1 | .8 | .3 | .2 | .4 |
| 26 | .55 | 1.45 | .25 | .6 | 1.7 | 2.15 | .8 | .3 | .35 | .35 |
| 27 | .4 | 1.3 | .25 | .65 | 1.7 | 2.25 | .8 | .3 | .3 | .3 |
| 28 | .3 | 1.3 | .25 | .75 | 1.75 | 2.15 | .85 | .3 | .35 | .35 |
| 29 | .15 | ........ | .25 | .7 | 1.85 | 2.05 | .9 | .3 | .3 | .25 |
| 30 | .2 | ........ | .2 | .7 | 2.2 | 1.9 | .8 | .3 | .4 | .25 |
| 31 | .4 | ........ | .2 | ........ | 2.5 | ........ | .8 | .3 | ........ | .25 |

NOTE.—River frozen January 12-25, also February 1-28. Readings to top of ice. Ice gorge below station during February.

*Station rating table for Big Blackfoot River near Bonner, Mont., from January 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.10 | 340 | 1.10 | 1,030 | 2.10 | 1,970 | 3.10 | 3,150 |
| 0.20 | 390 | 1.20 | 1,120 | 2.20 | 2,080 | 3.20 | 3,290 |
| 0.30 | 440 | 1.30 | 1,210 | 2.30 | 2,190 | 3.30 | 3,430 |
| 0.40 | 500 | 1.40 | 1,300 | 2.40 | 2,300 | 3.40 | 3,590 |
| 0.50 | 560 | 1.50 | 1,390 | 2.50 | 2,420 | 3.50 | 3,750 |
| 0.60 | 630 | 1.60 | 1,480 | 2.60 | 2,540 | 3.60 | 3,910 |
| 0.70 | 700 | 1.70 | 1,570 | 2.70 | 2,660 | 3.70 | 4,090 |
| 0.80 | 770 | 1.80 | 1,660 | 2.80 | 2,780 | 3.80 | 4,270 |
| 0.90 | 850 | 1.90 | 1,760 | 2.90 | 2,900 | 3.90 | 4,450 |
| 1.00 | 940 | 2.00 | 1,860 | 3.00 | 3,020 | 4.00 | 4,630 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1904–1905, and is fairly well defined throughout.

*Estimated monthly discharge of Big Blackfoot River near Bonner, Mont., for 1905.*

[Drainage area, 2,465 square miles.]

| Month | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 1-11, 27-31 | 1,120 | 365 | 572 | 18,150 | 0.232 | 0.138 |
| March | 940 | 320 | 459 | 28,220 | .186 | .214 |
| April | 735 | 365 | 463 | 27,550 | .188 | .210 |
| May | 2,420 | 700 | 1,294 | 79,560 | .525 | .605 |
| June | 4,360 | 1,760 | 2,936 | 174,700 | 1.19 | 1.33 |
| July | 1,760 | 770 | 1,079 | 66,350 | .437 | .504 |
| August | 735 | 440 | 565 | 34,740 | .229 | .264 |
| September | 500 | 340 | 407 | 24,220 | .165 | .184 |
| October | 560 | 365 | 465 | 28,590 | .189 | .218 |
| The period | | | | 482,100 | | |

NOTE.—No estimate for ice period.

## BITTERROOT RIVER NEAR GRANTSDALE, MONT.

This station was established April 25, 1902. It is located on the highway bridge 2 miles southwest of Grantsdale and 5 miles southwest of Hamilton, Mont. Two large ditches—the New Hedge and the Republican—are taken out of the river some distance above the station. They irrigate extensive farm lands and orchards in the vicinity of Hamilton.

The channel is straight both above and below the station. The stream has a moderate velocity at ordinary stages, but is extremely swift in high water. The right bank has a gentle slope for about 100 feet, when it terminates at a high bank which is not liable to overflow. The left bank is high and formed above the bridge by a railway fill. The bed of the stream is composed of gravel and bowlders.

Discharge measurements are made from the downstream side of the highway bridge, with the aid of a stay wire. The initial point for soundings is a notch on the hand rail over the northwest bridge pier at the left bank.

A standard chain gage is fastened to the downstream truss of the bridge; length of chain, 23.33 feet. During 1905 the gage was read once each day by T. J. Holt. Bench marks were established as follows: (1) A wire nail driven in the northeast side of a pine stump across the road from the west end of the bridge; elevation, 24.40 feet. (2) The northwest bolt in the northwest abutment plate of the bridge; elevation, 19.36 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 201; 100, p 408; 135, p 35.
Discharge: 85, p 202; 100, p 408; 135, p 35.
Discharge, monthly: 85, p 203; 100, p 410; 135, p 37.
Gage heights: 85, p 202; 100, p 409; 135, p 36.
Rating tables: 85, p 203; 100, p 409; 135, p 36.

### *Discharge measurements of Bitterroot River near Grantsdale, Mont., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | Stockman and Sloan | 170 | 412 | 1.73 | 2.22 | 713 |
| May 6 | J. H. Sloan | 170 | 420 | 2.17 | 2.42 | 910 |
| May 23 | do | 182 | 562 | 3.43 | 3.22 | 1,929 |
| June 17 | do | 183 | 588 | 3.85 | 3.50 | 2,265 |
| July 11 | do | 183 | 516 | 2.63 | 2.88 | 1,356 |
| August 11 | do | 168 | 268 | .75 | 1.51 | 200 |
| September 6 | do | 156 | 221 | .33 | 1.21 | 70 |
| October 4 | do | 168 | 259 | .64 | 1.46 | 167 |
| October 25 | Morse and Sloan | 168 | 298 | 1.06 | 1.70 | 315 |

### *Daily gage height, in feet, of Bitterroot River near Grantsdale, Mont., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.85 | 1.95 | 1.65 | 1.75 | 2.8 | 4.3 | 3.6 | 1.8 | 1.2 | 1.5 | 1.6 | 1.6 |
| 2 | 1.85 | 1.95 | 1.65 | 1.75 | 2.7 | 4.5 | 3.5 | 1.8 | 1.2 | 1.5 | 1.6 | 1.6 |
| 3 | 1.75 | 1.95 | 1.75 | 1.75 | 2.6 | 4.6 | 3.4 | 1.8 | 1.2 | 1.5 | 1.6 | 1.6 |
| 4 | 1.75 | 1.95 | 1.75 | 1.75 | 2.5 | 4.6 | 3.4 | 1.7 | 1.2 | 1.4 | 1.6 | 1.6 |
| 5 | 1.75 | 1.95 | 1.85 | 1.95 | 2.4 | 4.5 | 3.3 | 1.7 | 1.3 | 1.4 | 1.6 | 1.6 |
| 6 | 1.65 | 1.95 | 1.85 | 1.95 | 2.4 | 4.3 | 3.2 | 1.7 | 1.3 | 1.4 | 1.6 | 2.0 |
| 7 | 1.65 | 1.95 | 1.95 | 2.15 | 2.5 | 4.2 | 3.0 | 1.6 | 1.2 | 1.4 | 1.6 | 2.0 |
| 8 | 1.65 | 2.05 | 1.95 | 2.15 | 2.6 | 4.3 | 2.9 | 1.6 | 1.2 | 1.4 | 1.5 | 1.9 |
| 9 | 1.65 | 2.05 | 1.95 | 2.25 | 2.8 | 4.9 | 2.9 | 1.5 | 1.2 | 1.5 | 1.5 | 2.1 |
| 10 | 1.85 | 2.15 | 1.95 | 2.25 | 2.9 | 4.5 | 2.8 | 1.5 | 1.2 | 1.5 | 1.5 | 2.1 |
| 11 | 1.95 | 2.15 | 1.95 | 2.15 | 2.8 | 4.5 | 2.8 | 1.4 | 1.2 | 1.5 | 1.5 | 2.1 |
| 12 | 1.95 | 2.25 | 1.85 | 2.15 | 2.7 | 4.4 | 2.7 | 1.4 | 1.2 | 1.6 | 1.5 | 2.1 |
| 13 | 2.15 | 2.35 | 1.85 | 2.05 | 2.6 | 4.3 | 2.6 | 1.4 | 1.1 | 1.6 | 1.5 | 2.1 |
| 14 | 2.25 | 2.45 | 1.95 | 2.05 | 2.6 | 4.2 | 2.5 | 1.4 | 1.1 | 1.7 | 1.5 | 2.0 |
| 15 | 2.35 | 2.45 | 1.95 | 2.05 | 2.5 | 4.0 | 2.5 | 1.3 | 1.1 | 1.7 | 1.5 | 1.9 |
| 16 | 2.35 | 2.45 | 1.95 | 2.15 | 2.5 | 3.8 | 2.4 | 1.3 | 1.1 | 1.7 | 1.5 | 1.8 |
| 17 | 2.35 | 1.95 | 1.95 | 2.05 | 3.1 | 3.5 | 2.4 | 1.3 | 1.1 | 1.7 | 1.6 | 1.8 |
| 18 | 2.35 | 1.95 | 2.05 | 2.15 | 3.5 | 3.3 | 2.3 | 1.3 | 1.1 | 1.6 | 1.6 | 1.8 |
| 19 | 1.75 | 1.85 | 2.05 | 2.2 | 3.4 | 3.2 | 2.3 | 1.3 | 1.0 | 1.6 | 1.6 | 2.1 |
| 20 | 1.75 | 1.85 | 2.05 | 2.5 | 3.5 | 3.2 | 2.2 | 1.4 | 1.0 | 1.6 | 1.6 | 2.1 |
| 21 | 1.75 | 1.85 | 1.95 | 2.6 | 3.4 | 3.2 | 2.2 | 1.4 | 1.0 | 1.6 | 1.6 | 2.1 |
| 22 | 1.65 | 1.85 | 1.95 | 2.6 | 3.3 | 3.4 | 2.1 | 1.3 | 1.0 | 1.6 | 1.6 | 2.0 |
| 23 | 1.65 | 1.75 | 1.95 | 2.8 | 3.2 | 3.6 | 2.1 | 1.3 | 1.1 | 1.5 | 1.7 | 2.0 |
| 24 | 1.65 | 1.75 | 1.95 | 3.0 | 3.1 | 3.7 | 2.1 | 1.2 | 1.1 | 1.5 | 1.7 | 2.0 |
| 25 | 1.65 | 1.75 | 1.95 | 3.2 | 3.0 | 3.7 | 2.0 | 1.4 | 1.1 | 1.6 | 1.8 | 2.0 |
| 26 | 1.65 | 1.75 | 1.95 | 3.4 | 2.9 | 3.7 | 2.0 | 1.3 | 1.2 | 1.7 | 1.8 | 2.0 |
| 27 | 1.65 | 1.65 | 1.95 | 3.2 | 3.0 | 4.1 | 2.0 | 1.3 | 1.2 | 1.7 | 1.7 | 1.6 |
| 28 | 1.65 | 1.65 | 1.95 | 3.0 | 3.1 | 3.9 | 1.9 | 1.2 | 1.3 | 1.7 | 1.7 | 1.6 |
| 29 | 1.65 | | 1.95 | 2.9 | 3.1 | 3.7 | 1.9 | 1.2 | 1.4 | 1.7 | 1.7 | 1.7 |
| 30 | 1.65 | | 1.85 | 2.8 | 3.6 | 3.6 | 1.8 | 1.2 | 1.4 | 1.7 | 1.7 | 1.8 |
| 31 | 1.65 | | 1.85 | | 4.0 | | 1.8 | 1.2 | | 1.7 | | 1.8 |

NOTE.—Ice conditions January 1-18, February 1-18, December 6-27. During February the ice increased from 0.3 to 0.9 foot in thickness. Readings are to top of ice.

*Station rating table for Bitterroot River near Grantsdale, Mont., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 15 | 2.10 | 635 | 3.10 | 1,695 | 4.10 | 3,435 |
| 1.20 | 50 | 2.20 | 725 | 3.20 | 1,825 | 4.20 | 3,660 |
| 1.30 | 95 | 2.30 | 820 | 3.30 | 1,965 | 4.30 | 3,885 |
| 1.40 | 145 | 2.40 | 920 | 3.40 | 2,105 | 4.40 | 4,110 |
| 1.50 | 200 | 2.50 | 1,020 | 3.50 | 2,265 | 4.50 | 4,335 |
| 1.60 | 260 | 2.60 | 1,120 | 3.60 | 2,435 | 4.60 | 4,560 |
| 1.70 | 325 | 2.70 | 1,225 | 3.70 | 2,615 | 4.70 | 4,785 |
| 1.80 | 395 | 2.80 | 1,335 | 3.80 | 2,805 | 4.80 | 5,010 |
| 1.90 | 470 | 2.90 | 1,450 | 3.90 | 3,005 | 4.90 | 5,235 |
| 2.00 | 550 | 3.00 | 1,570 | 4.00 | 3,215 | 5.00 | 5,460 |

NOTE.—The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904–5. It is well defined throughout.

*Estimated monthly discharge of Bitterroot River near Grantsdale, Mont., for 1905.*

[Drainage area, 1,550 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January 19-31 | 392 | 360 | 385 | 9,927 | 0.248 | 0.120 |
| February 19-28 | 428 | 360 | 394 | 7,815 | .254 | .094 |
| March | 592 | 360 | 485 | 29,820 | .313 | .361 |
| April | 2,105 | 360 | 915 | 54,450 | .590 | .658 |
| May | 3,215 | 920 | 1,544 | 94,940 | .996 | 1.15 |
| June | 5,235 | 1,825 | 3,276 | 194,900 | 2.11 | 2.35 |
| July | 2,435 | 395 | 1,111 | 68,310 | .717 | .827 |
| August | 395 | 50 | 168 | 10,330 | .108 | .124 |
| September | 145 | 5 | 44 | 2,636 | .029 | .032 |
| October | 325 | 145 | 247 | 15,190 | .159 | .183 |
| November | 395 | 200 | 264 | 15,710 | .170 | .190 |
| December 1-5 | 260 | 260 | 260 | 2,578 | .168 | .031 |
| The period | | | | 506,600 | | |

NOTE.—No estimate for ice period.

## PRIEST RIVER AT PRIEST RIVER, IDAHO.

This station was established in June, 1903, by T. A. Noble, and discontinued April 30, 1905. It is located at the highway bridge on the road from the railroad station at Priest River to Priest Lake.

The channel is straight for 500 feet above and 200 feet below the bridge. Both banks are high, wooded, and not liable to overflow. Extending from each pier of the single-span bridge to the bank is a breakwater composed of piles faced with planks. These breakwaters make the current sluggish between the piers and the banks. Under the main span of the bridge, a distance of 120 feet, the current is swift. The bed of the stream is composed of gravel.

Discharge measurements were made from the downstream side of the bridge. The initial point for soundings is the bolt, around which a circle has been painted, at the end of the guard rail at the right bank.

A vertical staff gage is nailed to a pile on the downstream side of the right pier of the bridge. During the early part of 1905 the gage was read once each day by George Young. Bench marks were established as follows: (1) The bolt in the guard rail at the west end of the bridge, which is used as initial point for soundings; elevation, 29.04 feet. (2) A spike driven into a stump under the right approach to the bridge; elevation, 17.48 feet. Elevations refer to the datum of the gage. Bench mark No. 1 is 2,079.7 feet above sea level.

January 18, 1905, a discharge measurement made at this station by Laurgaard and Casteel gave the following results: Width, 127 feet; area of section, 321 square feet; mean velocity, 2.10 feet per second; gage height, 3.22 feet; discharge, 637 second-feet. There was ice along the river banks at the time of the measurement.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p. 401; 135, pp. 43–44.
Discharge: 100, p. 402; 135, p. 44.
Discharge, monthly: 135, p. 46.
Gage heights: 100, p. 402; 135, pp. 44–45.
Rating table: 135, p. 45.

*Daily gage height, in feet, of Priest River at Priest River, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1...... | 3.22 | 2.9 | 3.59 | 4.68 | 12..... | 3.52 | 3.52 | 3.98 | 4.53 | 22..... | 3.26 | 3.59 | 4.59 | 4.65 |
| 2...... | 3.1 | 3.3 | 3.64 | 4.65 | 13..... | 3.9 | 3.71 | 3.97 | 4.55 | 23..... | 3.27 | 3.6 | 4.59 | 4.68 |
| 3...... | 3.22 | 3.52 | 3.74 | 4.61 | 14..... | 4.31 | 3.7 | 3.95 | 4.58 | 24..... | 3.34 | 3.62 | 4.68 | 4.7 |
| 4...... | 3.23 | 3.63 | 3.86 | 4.57 | 15..... | 3.95 | 3.62 | 3.97 | 4.6 | 25..... | 3.41 | 3.6 | 4.69 | 4.79 |
| 5...... | 3.3 | 3.45 | 3.78 | 4.54 | 16..... | 3.62 | 3.65 | 3.99 | 4.68 | 26..... | 3.45 | 3.60 | 4.68 | 4.91 |
| 6...... | 3.31 | 3.21 | 3.88 | 4.55 | 17..... | 3.43 | 3.66 | 3.99 | 4.55 | 27..... | 3.5 | 3.81 | 4.69 | 5.09 |
| 7...... | 3.3 | 3.39 | 3.91 | 4.55 | 18..... | 3.28 | 3.67 | 4.11 | 4.6 | 28..... | 3.64 | 3.61 | 4.69 | 5.11 |
| 8...... | 3.31 | 3.49 | 3.93 | 4.57 | 19..... | 3.26 | 3.61 | 4.14 | 4.52 | 29..... | 3.67 | ...... | 4.67 | 5.12 |
| 9...... | 3.15 | 3.49 | 3.97 | 4.58 | 20..... | 3.27 | 3.62 | 4.25 | 4.58 | 30..... | 3.48 | ...... | 4.68 | 5.19 |
| 10...... | 3.13 | 3.42 | 4.01 | 4.54 | 21..... | 3.27 | 3.59 | 4.51 | 4.62 | 31..... | 3.45 | ...... | 4.69 | ...... |
| 11...... | 3.05 | 3.05 | 4.03 | 4.53 |  |  |  |  |  |  |  |  |  |  |

NOTE.—No ice record.

## SPOKANE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Spokane River rises in the northern part of Idaho, being an outlet of Lake Cœur d'Alene. It passes into Washington, flows in a westerly direction, and enters Columbia River near latitude 47° 52′ north. It is about 120 miles long.

### CŒUR D'ALENE LAKE AT CŒUR D'ALENE, IDAHO.

This station was established February 11, 1905, to obtain a record of the fluctuations of the lake surface, and was discontinued September 30, 1905.

A vertical staff gage is nailed to a pile in front of Rosen's boathouse, 400 feet east of the Cœur d'Alene Railroad depot. During 1905 the gage was read once each day by John C Rosen. The bench mark is a United States Geological Survey standard bench-mark tablet in the southeast corner of Wiggett & Empey Company's brick store building, 37.65 feet above the datum of the gage and 2,157.00 feet above sea level.

*Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.55 | 4.25 | 5.1 | 5.15 | 3.1 | 1.05 | 0.35 |
| 2 | ........ | 1.7 | 4.2 | 5.0 | 5.15 | 3.05 | 1.0 | .3 |
| 3 | ........ | 1.8 | 4.1 | 4.85 | 5.15 | 2.95 | .95 | .3 |
| 4 | ........ | 2.0 | 4.0 | 4.75 | 5.2 | 2.9 | .95 | .3 |
| 5 | ........ | 2.2 | 3.9 | 4.65 | 5.3 | 2.8 | .9 | .3 |
| 6 | ........ | 2.4 | 3.85 | 4.4 | 5.4 | 2.65 | .85 | .3 |
| 7 | ........ | 2.6 | 3.85 | 4.4 | 5.45 | 2.55 | .8 | .3 |
| 8 | ........ | 2.7 | 3.85 | 4.3 | 5.45 | 2.5 | .8 | .25 |
| 9 | ........ | 2.8 | 3.9 | 4.35 | 5.4 | 2.4 | .75 | .25 |
| 10 | ........ | 2.9 | 4.0 | 4.6 | 5.4 | 2.3 | .7 | .25 |
| 11 | ........ | 2.95 | 4.05 | 4.7 | 5.3 | 2.2 | .7 | .25 |
| 12 | ........ | 3.0 | 4.05 | 4.85 | 5.2 | 2.15 | .65 | .2 |
| 13 | ........ | 3.05 | 4.0 | 4.95 | 5.05 | 2.05 | .65 | .2 |
| 14 | ........ | 3.05 | 4.0 | 5.0 | 4.95 | 2.0 | .6 | .2 |
| 15 | 0.85 | 3.05 | 3.9 | 5.0 | 4.8 | 1.9 | .6 | .2 |
| 16 | .85 | 3.0 | 3.9 | 5.05 | 4.65 | 1.85 | .55 | .2 |
| 17 | .8 | 3.0 | 3.85 | 5.1 | 4.5 | 1.8 | .55 | .2 |
| 18 | .75 | 3.0 | 3.85 | 5.15 | 4.35 | 1.7 | .5 | .2 |
| 19 | .8 | 3.15 | 3.9 | 5.2 | 4.2 | 1.65 | .5 | .2 |
| 20 | .8 | 3.3 | 4.0 | 5.2 | 4.05 | 1.6 | .5 | .2 |
| 21 | .8 | 3.4 | 4.15 | 5.25 | 3.9 | 1.55 | .5 | .2 |
| 22 | .8 | 3.55 | 4.3 | 5.25 | 3.8 | 1.5 | .45 | .2 |
| 23 | .9 | 3.65 | 4.4 | 5.25 | 3.75 | 1.45 | .45 | .2 |
| 24 | .95 | 3.75 | 4.55 | 5.25 | 3.6 | 1.45 | .45 | .15 |
| 25 | 1.05 | 3.85 | 4.7 | 5.25 | 3.5 | 1.35 | .4 | .15 |
| 26 | 1.2 | 4.0 | 4.9 | 5.2 | 3.45 | 1.3 | .4 | .2 |
| 27 | 1.3 | 4.15 | 5.1 | 5.2 | 3.4 | 1.25 | .4 | .25 |
| 28 | 1.45 | 4.25 | 5.25 | 5.15 | 3.35 | 1.2 | .4 | .3 |
| 29 | ........ | 4.35 | 5.25 | 5.15 | 3.25 | 1.15 | .4 | .35 |
| 30 | ........ | 4.4 | 5.15 | 5.15 | 3.15 | 1.1 | .35 | .4 |
| 31 | ........ | 4.35 | ........ | 5.15 | ........ | 1.1 | .35 | ........ |

## SPOKANE RIVER AT SPOKANE, WASH.

This gaging station was originally established October 17, 1896, by C. C. Babb, on the Oregon Railroad and Navigation Company's wooden bridge, about 1 mile above the falls, where discharge measurements and gage readings were taken until July 8, 1903, the gage datum being 1,880 feet above sea level by city datum and 1,865 feet by Government datum.

March 30, 1904, a cable station was established about one-half mile above the Mission Street Bridge, or 1 mile above the former station at the Oregon Railroad and Navigation Company's bridge. The station is equipped with a cable, stay wire, and tag wire. The section here is a good one for stream measurements; the bed is composed of gravel and small bowlders and not liable to change. The banks on both sides are high and will not overflow. The current, except at the lowest stages, is swift.

Since the date of establishing, owing to various conditions, it has been necessary to put in several gages. During 1905 a vertical gage was fastened to the inside of the most easterly pier on the south side of the Mission Street Bridge, and was used until April 17, 1905, when a new gage was erected 200 feet upstream from the cable, on the right bank. The elevation of the zero is 1,851.926 feet above sea level. From 0 to 21.6 feet the gage is an inclined section on the bank of the river; from 21.6 to 29.2 feet it is a vertical section fastened to a tree.

During 1905 the gage was read once each day, by A. C. Lingle.

Bench marks were established as follows: (1) Top of a granite bowlder 15 feet west of the cable post on the right bank of the river, marked "B. M." cut in the stone; elevation, 30.36 feet; (2) chisel draft on a bowlder between shear poles and water's edge, elevation 27.44 feet. Elevations refer to datum of the gage, which is 1,851.93 feet above sea level.

November 24, 1905, a discharge measurement made at this station by W. C. Sawyer gave the following results: Width, 215 feet; area of section, 1,894 square feet; mean velocity, 1.11 feet per second; gage height, 1.96 feet; discharge, 2,100 second-feet.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: Ann 18, iv, pp 359–360; 20, iv, p 510; WS 16, p 177; 28, p 159; 38, pp 370–371; 51, pp 438–439; 66, p 133; 85, pp 196–197; 100, p 396; 135, pp 46–48.
Discharge: Ann 18, iv, p 360; 19, iv, p 460; WS 16, p 177; 28, p 169; 38, p 371; 51, p 49; 135, p 48.
Discharge, monthly: Ann 19, iv, p 488; 20, iv, p 511; 21, iv, p 424; 22, iv, p 443; WS 75, p 200; 85, p 198; 135, pp 50–51.
Discharge, yearly: Ann 20, iv, p 63.
Gage heights: WS 11, p 88; 16, p 177; 28, p 166; 38, p 371; 51, p 439; 66, p 133; 85, p 197; 100, p 397; 135, p 49.
Hydrographs: Ann 19, iv, p 489; 20, iv, p 511; 21, iv, p 425; 22, iv, p 443; WS 75, p 200;
Rating tables: Ann 19, iv, p 488; WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 85, p 198; 135, p 50.

*Daily gage height, in feet, of Spokane River at Spokane, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.94 | 2.05 | 2.25 | 5.0 | 5.74 | 5.7 | 4.07 | 2.22 | 1.43 | 1.42 | 2.3 | 2.23 |
| 2 | 2.01 | 2.06 | 2.37 | 4.93 | 5.63 | 5.72 | 4.02 | 2.15 | 1.46 | 1.87 | 2.31 | 2.24 |
| 3 | 2.09 | 2.03 | 2.47 | 4.88 | 5.53 | 5.76 | 3.97 | 2.12 | 1.32 | 1.9 | 2.32 | 2.24 |
| 4 | 2.12 | 1.96 | 2.61 | 4.82 | 5.47 | 5.8 | 3.9 | 2.11 | 1.5 | 1.72 | 2.33 | 2.31 |
| 5 | 2.11 | 1.96 | 2.79 | 4.74 | 5.4 | 5.85 | 3.8 | 2.05 | 1.31 | 1.75 | 2.31 | 2.21 |
| 6 | 2.11 | 1.97 | 3.0 | 4.7 | 5.3 | 5.87 | 3.7 | 2.0 | 1.36 | 1.8 | 2.27 | 2.23 |
| 7 | 2.1 | 1.97 | 3.21 | 4,65 | 5.18 | 5.94 | 3.63 | 1.97 | 1.44 | 1.92 | 2.28 | 2.22 |
| 8 | 2.07 | 1.99 | 3.36 | 4.63 | 5.1 | 6.0 | 3.57 | 1.9 | 1.61 | 2.03 | 2.27 | 2.2 |
| 9 | 2.05 | 1.99 | 3.49 | 4.7 | 5.17 | 5.92 | 3.5 | 1.85 | 1.63 | 2.12 | 2.22 | 2.2 |
| 10 | 2.02 | 1.96 | 3.56 | 4.73 | 5.24 | 5.92 | 3.42 | 1.81 | 1.73 | 2.14 | 2.21 | 2.19 |
| 11 | 1.99 | 1.92 | 3.6 | 4.78 | 5.42 | 5.87 | 3.33 | 1.94 | 1.69 | 2.3 | 2.15 | 2.17 |
| 12 | 1.95 | 1.9 | 3.7 | 4.79 | 5.51 | 5.82 | 3.24 | 1.83 | 1.62 | 2.35 | 2.12 | 2.15 |
| 13 | 1.9 | 1.87 | 3.74 | 4.8 | 5.59 | 5.76 | 3.16 | 1.7 | 1.69 | 2.43 | 2.10 | 2.13 |
| 14 | 1.85 | 1.85 | 3.8 | 4.78 | 5.67 | 5.66 | 3.1 | 1.7 | 1.67 | 2.4 | 2.10 | 2.09 |
| 15 | 1.81 | 1.83 | 3.83 | 4.74 | 5.64 | 5.52 | 3.03 | 1.65 | 1.7 | 2.4 | 2.09 | 2.05 |
| 16 | 1.8 | 1.82 | 3.83 | 4.71 | 5.67 | 5.4 | 2.97 | 1.63 | 1.65 | 2.38 | 2.08 | 2.03 |
| 17 | 1.8 | 1.8 | 3.8 | 4.7 | 5.7 | 5.22 | 2.9 | 1.57 | 1.63 | 2.4 | 2.07 | 2.08 |
| 18 | 1.8 | 1.79 | 3.82 | 4.69 | 5.73 | 5.17 | 2.81 | 1.62 | 1.66 | 2.38 | 2.02 | 2.1 |
| 19 | 1.8 | 1.77 | 3.9 | 4.73 | 5.8 | 5.05 | 2.8 | 1.6 | 1.72 | 2.36 | 2.0 | 2.12 |
| 20 | 1.81 | 1.78 | 4.0 | 4.77 | 5.8 | 4.92 | 2.75 | 1.58 | 1.68 | 2.4 | 2.0 | 2.19 |
| 21 | 1.8 | 1.77 | 4.15 | 4.85 | 5.82 | 4.8 | 2.68 | 1.55 | 1.57 | 2.33 | 2.0 | 2.2 |
| 22 | 1.79 | 1.78 | 4.27 | 4.96 | 5.84 | 4.72 | 2.62 | 1.53 | 1.71 | 2.32 | 1.99 | 2.2 |
| 23 | 1.8 | 1.78 | 4.37 | 5.08 | 5.82 | 4.62 | 2.58 | 1.52 | 1.67 | 2.3 | 2.0 | 2.21 |
| 24 | 1.81 | 1.78 | 4.48 | 5.15 | 5.84 | 4.57 | 2.53 | 1.5 | 1.51 | 2.28 | 1.92 | 2.2 |
| 25 | 1.81 | 1.84 | 4.55 | 5.3 | 5.81 | 4.46 | 2.49 | 1.46 | 1.52 | 2.35 | 2.03 | 2.19 |
| 26 | 1.85 | 1.92 | 4.64 | 5.44 | 5.81 | 4.4 | 2.43 | 1.44 | 1.5 | 2.36 | 2.1 | 2.2 |
| 27 | 1.86 | 2.0 | 4.74 | 5.61 | 5.81 | 4.35 | 2.4 | 1.44 | 1.49 | 2.21 | 2.2 | 2.2 |
| 28 | 1.92 | 2.11 | 4.88 | 5.74 | 5.8 | 4.3 | 2.34 | 1.4 | 1.3 | 2.23 | 2.17 | 2.18 |
| 29 | 1.99 | ....... | 4.95 | 5.78 | 5.8 | 4.24 | 2.3 | 1.38 | 1.32 | 2.29 | 2.14 | 2.17 |
| 30 | 2.03 | ....... | 5.0 | 5.76 | 5.78 | 4.17 | 2.27 | 1.4 | 1.3 | 2.3 | 2.19 | 2.16 |
| 31 | 2.04 | ....... | 5.03 | ....... | 5.78 | ....... | 2.24 | 1.52 | ....... | 2.31 | ....... | 2.17 |

NOTE.—No ice record.

*Station rating table for Spokane River at Spokane, Wash., from April 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 940 | 2.70 | 3,260 | 4.30 | 6,090 | 6.80 | 11,340 |
| 1.10 | 1,030 | 2.80 | 3,420 | 4.40 | 6,280 | 7.00 | 11,830 |
| 1.20 | 1,130 | 2.90 | 3,660 | 4.50 | 6,470 | 7.20 | 12,330 |
| 1.30 | 1,240 | 3.00 | 3,740 | 4.60 | 6,660 | 7.40 | 12,850 |
| 1.40 | 1,360 | 3.10 | 3,910 | 4.70 | 6,850 | 7.60 | 13,380 |
| 1.50 | 1,490 | 3.20 | 4,080 | 4.80 | 7,050 | 7.80 | 13,930 |
| 1.60 | 1,620 | 3.30 | 4,250 | 4.90 | 7,250 | 8.00 | 14,490 |
| 1.70 | 1.760 | 3.40 | 4,420 | 5.00 | 7,450 | 8.20 | 15,050 |
| 1.80 | 1,900 | 3.50 | 4,600 | 5.20 | 7,850 | 8.40 | 15,610 |
| 1.90 | 2,040 | 3.60 | 4,780 | 5.40 | 8,250 | 8.60 | 16,190 |
| 2.00 | 2,190 | 3.70 | 4,960 | 5.60 | 8,660 | 8.80 | 16,780 |
| 2.10 | 2,340 | 3.80 | 5,140 | 5.80 | 9,080 | 9.00 | 17,380 |
| 2.20 | 2,490 | 3.90 | 5,330 | 6.00 | 9,510 | 9.50 | 18,980 |
| 2.30 | 2,640 | 4.00 | 5,520 | 6.20 | 9,950 | 10.00 | 20,580 |
| 2.40 | 2,790 | 4.10 | 5,710 | 6.40 | 10,400 | 10.50 | 22,280 |
| 2.50 | 2,940 | 4.20 | 5,900 | 6.60 | 10,860 | 11.00 | 23,980 |
| 2.60 | 3.100 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 20 discharge measurements made during 1904 and one made during 1905. It is well defined between gage heights 1.4 feet and 12 feet. Above gage height 11 feet the rating curve is a tangent, the difference being 360 per tenth.

*Estimated monthly discharge of Spokane River at Spokane, Wash., for 1905.*

[Drainage area 4,005 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,370 | 1,886 | 2,089 | 128,400 | 0.522 | 0.602 |
| February | 2,355 | 1,858 | 2,047 | 113,700 | .511 | .532 |
| March | 7,510 | 2,565 | 5,223 | 321,200 | 1.30 | 1.50 |
| April | 9,038 | 6,717 | 7,383 | 439,300 | 1.84 | 2.05 |
| May | 9,164 | 7,650 | 8,706 | 535,300 | 2.17 | 2.50 |
| June | 9,510 | 5,843 | 7,974 | 474,500 | 1.99 | 2.22 |
| July | 5,653 | 2,550 | 3,865 | 237,600 | .965 | 1.11 |
| August | 2,520 | 1,336 | 1,789 | 110,000 | .447 | .515 |
| September | 1,802 | 1,240 | 1,555 | 92,530 | .388 | .433 |
| October | 2,835 | 1,386 | 2,472 | 152,000 | .617 | .711 |
| November | 2,885 | 2,070 | 2,411 | 143,500 | .602 | .672 |
| December | 2,655 | 2,235 | 2,454 | 150,900 | .613 | .707 |
| The year | 9,510 | 1,240 | 3,997 | 2,899,000 | .997 | 13.55 |

## HANGMAN CREEK AT TEKOA, WASH.

This station was established April 1, 1904, by W. W. Schlecht, and discontinued September 30, 1905. It is located at the footbridge across Hangman Creek about 1,000 feet above the mouth of North Fork of Hangman Creek, in Tekoa, Wash. There is a fall of about 2½ feet between the two points.

The channel is straight for about 75 feet above and 40 feet below the station. The current is sluggish. About 50 feet below the station is the head of a series of rapids. The right bank is fringed with brush and liable to overflow to the railroad embankment, about 50 feet. The left bank is high, steep, composed of clay, fringed with brush, and not subject to overflow. The bed of the stream is composed of solid rock with earth banks and is not liable to shift. The station may at times be affected by backwater from North Fork.

Discharge measurements are made from the downstream side of the footbridge. The initial point for soundings is the center of a telegraph pole on the right bank, marked with a 20-penny nail and zero.

A plain-staff gage is attached to the right pile bent of the bridge. During 1905 the gage was read once each day by A. C. McLaughlin. Bench marks were established as follows: (1) A standard United States Geological Survey tablet marked "2537" set in the vertical wall of a brick house on the corner one square north of the Bank of Tekoa; elevation, 62.11 feet. (2) Top of the head of a 60-penny spike driven into the telegraph pole at the initial point for soundings; elevation, 11.41 feet. Elevations refer to the datum of the gage.

A description of this station, with gage heights, discharge data, and rating table, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 51-54.

*Daily gage height, in feet, of Hangman Creek at Tekoa, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1 | 0.9 | 1.9 | 3.0 | 1.5 | 1.7 | 1.0 | 0.45 | 0.2 |
| 2 | .1 | .9 | 1.8 | 3.0 | 1.4 | 1.65 | 1.0 | .4 | .2 |
| 3 | .15 | .5 | 1.7 | 2.6 | 1.4 | 1.85 | .9 | .4 | .3 |
| 4 | .1 | .5 | 1.7 | 2.5 | 1.3 | 2.0 | .9 | .4 | .3 |
| 5 | .1 | .5 | 1.7 | 2.3 | 1.3 | 2.4 | .8 | .4 | .3 |
| 6 | .9 | .4 | 1.7 | 2.2 | 1.2 | 2.8 | .8 | .4 | .3 |
| 7 | .9 | .4 | 1.6 | 2.2 | 1.0 | 3.6 | .85 | .45 | .3 |
| 8 | .8 | .4 | 1.5 | 2.0 | 1.0 | 2.9 | .7 | [a].3 | .3 |
| 9 | .75 | .3 | 1.5 | 2.0 | 1.5 | 2.3 | .7 | .3 | .3 |
| 10 | .7 | .3 | 1.5 | 2.0 | 1.8 | 2.0 | .7 | .3 | .3 |
| 11 | .65 | .1 | 1.5 | 1.9 | 1.6 | 2.0 | .7 | .3 | .3 |
| 12 | .65 | .2 | 1.5 | 1.8 | 1.5 | 1.9 | .6 | .3 | .3 |
| 13 | .65 | .3 | 1.47 | 1.7 | 2.6 | 1.8 | .6 | .3 | .3 |
| 14 | .65 | .3 | 1.47 | 1.7 | 2.5 | 1.5 | .6 | .3 | .3 |
| 15 | .65 | .4 | 1.47 | 1.5 | 2.3 | 1.55 | .6 | .3 | .3 |
| 16 | .65 | .5 | 1.47 | 1.7 | 2.0 | 1.3 | .65 | .3 | .3 |
| 17 | .65 | .6 | 1.47 | 1.9 | 1.9 | 1.3 | .65 | .3 | .4 |
| 18 | .6 | .6 | 1.3 | 2.0 | 1.8 | 1.2 | .65 | .3 | .4 |
| 19 | .6 | .7 | 2.0 | 2.0 | 1.6 | 1.15 | .65 | .3 | .4 |
| 20 | .6 | 1.2 | 2.0 | 2.8 | 1.6 | 1.1 | .65 | .3 | .4 |
| 21 | .6 | 1.6 | 2.1 | 3.6 | 1.6 | 1.0 | .6 | .3 | .4 |
| 22 | .1 | 1.4 | 2.1 | 3.3 | 1.6 | 1.0 | .6 | .3 | .4 |
| 23 | .18 | 1.5 | 2.2 | 2.7 | 1.7 | 1.0 | .55 | .3 | .4 |
| 24 | .26 | 1.7 | 2.3 | 2.3 | 1.8 | 1.2 | .55 | .3 | .4 |
| 25 | .28 | 1.9 | 3.0 | 2.0 | 2.6 | 1.2 | .55 | .3 | .4 |
| 26 | .25 | .2 | 3.6 | 1.9 | 2.8 | 1.0 | .55 | .3 | .5 |
| 27 | .25 | .2 | 3.8 | 1.77 | 2.5 | 1.15 | .5 | .2 | .5 |
| 28 | .19 | 1.9 | 3.35 | 1.7 | 2.2 | 1.3 | .5 | .2 | .6 |
| 29 | 1.8 | ........ | 3.3 | 1.5 | 2.1 | 1.2 | .5 | .2 | .6 |
| 30 | 1.8 | ........ | 3.3 | 1.5 | 1.97 | 1.0 | .45 | .2 | .6 |
| 31 | 1.8 | ........ | 3.3 | ........ | 1.8 | ........ | .45 | .2 | ........ |

[a] Water standing in pools.

NOTE.—Ice conditions January 22 to February 15 approximately. Gage read to water surface.

## HANGMAN CREEK AT POOLE'S RANCH, NEAR TEKOA, WASH.

This station was established September 28, 1904, by T. A. Noble, and discontinued September 30, 1905. It is located 4 miles northwest of Tekoa, Wash., one-fourth mile south of the highway bridge across Hangman Creek, and 300 feet south of J. M. Poole's farm crossing.

The channel is straight for about 80 feet above and 25 feet below the station, and the current is sluggish. Both banks are about 6 to 8 feet high, lined with brush, and subject to overflow during high water. The bed of the stream is composed of rock and cemented gravel, is free from vegetation, and is permanent. There is but one channel at low and two at high water.

Discharge measurements are made by means of a weir 14 feet long. The top of the weir is at the same height as the top of a nail driven into the plank which forms part of the deadman for the bench mark, 7 feet upstream from the weir.

During 1905 a 6-inch hook gage was used once each day by John M. Poole. The bench mark is the top of a 60-penny nail driven into the right-of-way post of the Oregon Railroad and Navigation Company, 40 feet east of the weir; elevation, 8.627 feet above the top of the weir or iron lip.

A description of this station, with gage heights, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 54–55.

*Daily discharge, in second-feet, of Hangman Creek at Poole's ranch, near Tekoa, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. | Day. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | [a] 16 | 5 | ...... | ...... | 10 | 7 | 9 | ...... | 58 | 18 | ...... | 6 | 30 | ...... |
| 2 | [b] 22 | ...... | ...... | ...... | 11 | 5 | 5 | ...... | 52 | 19 | ...... | 8 | ([e]) | ...... |
| 3 | 24 | 17 | ...... | ...... | 12 | 5 | 5 | ...... | 45 | 20 | ...... | ([f]) | ...... | ...... |
| 4 | 17 | 12 | ...... | ...... | 13 | ([c]) | 5 | ...... | 41 | 22 | ...... | ...... | 73 | ...... |
| 5 | 13 | 10 | ...... | 73 | 14 | ...... | 4 | ...... | 35 | 23 | ...... | ...... | 73 | ...... |
| 6 | 10 | 10 | ...... | 69 | 15 | ...... | 5 | ...... | 31 | 24 | ...... | ...... | ([f]) | ...... |
| 7 | 10 | 10 | ...... | 65 | 16 | ...... | 4 | [d] 32 | ...... | 30 | 16 | ...... | ...... | ...... |
| 8 | 9 | 8 | ...... | 64 | 17 | ...... | 4 | 27 | ...... | 31 | 6 | ...... | ...... | ...... |
| 9 | 8 | 6 | ...... | 61 | | | | | | | | | | |

[a] Length of weir 7 feet, January 1.
[b] Length of weir 10 feet, January 2–12, January 30 to February 19.
[c] River frozen up January 13–14.
[d] Length of weir 13 feet, March 16–18.
[e] Length of weir 12 feet 8 inches, March 19–23, April 5–15.
[f] River overflowed, February 20–25, March 24–25.

## NORTH FORK OF HANGMAN CREEK AT TEKOA, WASH.

This station was established April 2, 1904, by W. W. Schlecht, and discontinued September 30, 1905. It is located at the highway bridge in Tekoa, Wash., on the road leading north.

The channel is straight for about 60 feet above and below the station and the current is swift. There is a series of rapids between the gaging station and the mouth of the creek, having a total fall of about 4 to 5 feet. The right bank is of earth, fringed with brush, having a number of houses built close to the river, and does not overflow. The left bank is low, and is liable to overflow above and below the station 50 to 100 feet back to the railroad embankment. The bed of the stream is composed of gravel and a few bowlders, and is permanent. At the gaging section there is but one channel at all stages.

Discharge measurements are made from the downstream side of the highway bridge. The initial point for soundings is the center of telegraph pole on the right bank. It is indicated by a 20-penny nail and marked zero.

A plain-staff gage is fastened to the concrete abutment of the railway bridge on the northern arm of the "Y" of the Oregon Railroad and Navigation Company's tracks, 25 feet upstream from the bridge, from which discharge measurements are made. During 1905 the gage was read once each day by C. J. McLaughlin. Bench marks were established as follows: (1) A United States Geological Survey standard aluminum tablet set in the vertical wall of a brick house on the corner one square north of the bank in Tekoa, marked "2537;" elevation, 58.29 feet. (2) A point on the concrete abutment of the railroad bridge near the gage; elevation, 8.39 feet. Elevations refer to the datum of the gage.

April 9, 1905, a discharge measurement made at this station by Schlecht and Hoblen gave the following results: Width, 44 feet; area of section, 108 square feet; mean velocity, 1.09 feet per second; gage height, 1.88 feet; discharge, 117 second-feet.

A description of this station, with gage height, discharge data, and rating table, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 55-57.

*Daily gage height, in feet, of North Fork of Hangman Creek at Tekoa, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.99 | 0.8 | 2.0 | 2.5 | 1.8 | 1.8 | 1.5 | 0.35 | 0.5 |
| 2 | .99 | .8 | 1.9 | 2.5 | 1.7 | 1.8 | 1.5 | .4 | .5 |
| 3 | 1.0 | .4 | 1.9 | 2.4 | 1.7 | 2.4 | 1.4 | .4 | .5 |
| 4 | .97 | .4 | 1.9 | 2.4 | 1.7 | 2.4 | 1.4 | .4 | .5 |
| 5 | .8 | .4 | 1.7 | 2.4 | 1.7 | 2.3 | 1.4 | .4 | .5 |
| 6 | .75 | .3 | 1.4 | 2.4 | 1.7 | 1.4 | 1.4 | .4 | .5 |
| 7 | .65 | .3 | 1.3 | 2.4 | 1.7 | 2.3 | 1.3 | .4 | .5 |
| 8 | .6 | .3 | 1.2 | 2.3 | 1.65 | 2.3 | 1.3 | .4 | .5 |
| 9 | .55 | .2 | 1.0 | 2.3 | 1.7 | 2.1 | 1.3 | .35 | .5 |
| 10 | .55 | .2 | .9 | 2.3 | 1.6 | 2.0 | 1.2 | .35 | .5 |
| 11 | .55 | .2 | .9 | 2.1 | 1.5 | 1.9 | .9 | .35 | .5 |
| 12 | .55 | .3 | .9 | 2.0 | 1.5 | 1.8 | .8 | .4 | .5 |
| 13 | .5 | .3 | .8 | 1.9 | 1.6 | 1.7 | .8 | .4 | .5 |
| 14 | .5 | .4 | .8 | 1.9 | 2.5 | 1.7 | .35 | .5 | .5 |
| 15 | .5 | .4 | .8 | 1.8 | 2.5 | 1.5 | .35 | .5 | .5 |
| 16 | .5 | .4 | .8 | 1.8 | 2.4 | 1.5 | .5 | .5 | .5 |
| 17 | .5 | .5 | .8 | 1.8 | 2.3 | 1.5 | .5 | .5 | .5 |
| 18 | .5 | .6 | .8 | 1.9 | 1.8 | 1.5 | .4 | .5 | .5 |
| 19 | .49 | .7 | .8 | 2.0 | 1.8 | 1.5 | .4 | .5 | .5 |
| 20 | .49 | 1.0 | .8 | 2.2 | 1.8 | 1.3 | .4 | .5 | .5 |
| 21 | .48 | 1.5 | 1.0 | 2.3 | 1.8 | 1.2 | .45 | .5 | .5 |
| 22 | .48 | 1.5 | 1.3 | 2.3 | 1.8 | 1.2 | .45 | .5 | .5 |
| 23 | .1 | 1.4 | 1.3 | 2.2 | 1.9 | 1.3 | .45 | .5 | .5 |
| 24 | .15 | 1.4 | 1.4 | 2.1 | 1.9 | 1.6 | .45 | .5 | .5 |
| 25 | .15 | 1.5 | 1.5 | 2.0 | 1.9 | 1.5 | .45 | .5 | .5 |
| 26 | .1 | 1.7 | 2.9 | 2.0 | 1.9 | 1.7 | .4 | .5 | .5 |
| 27 | .1 | 1.9 | 2.7 | 1.9 | 1.8 | 1.7 | .3 | .5 | .5 |
| 28 | .1 | 2.2 | 2.5 | 1.8 | 1.8 | 1.65 | .3 | .5 | .6 |
| 29 | 1.1 | ........ | 2.6 | 1.8 | 2.3 | 1.55 | .3 | .5 | .6 |
| 30 | 1.1 | ........ | 2.6 | 1.8 | 2.0 | 1.5 | .35 | .5 | .6 |
| 31 | 1.1 | ........ | 2.6 | ........ | 1.9 | ........ | .35 | ........ | ........ |

NOTE.—Ice conditions during part of January and February. Gage read to water surface.

### LITTLE SPOKANE RIVER NEAR SPOKANE, WASH.

This station was established August 3, 1903, by George H. Bliss, and was discontinued March 31, 1905. It is located about 2 miles above the mouth of the river at the second bridge above the mouth. It is 9 miles northwest of Spokane, Wash., and 1½ miles northeast of what is known as the "9-mile bridge" over Spokane River.

The channel is straight for 100 feet above and 150 feet below the station. The current is swift. Both banks are high, covered with underbrush, and liable to overflow only at very high stages. The bed of the stream is composed of clean gravel. The channel is broken by four bridge piers and has a width at ordinary stages of about 125 feet.

Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The initial point for soundings is the vertical end post on the upstream side of the bridge at the south approach.

A wire gage is located on the upstream side of the bridge; length of wire, 13.25 feet. This distance has been laid off on the upper surface of the bottom rail near the gage and is marked by copper tacks inclosed in circles of black paint. These marks are used in checking the length of the gage wire. During 1905 the gage was read once each day by Mary A. Keenan. The bench mark is a wire nail driven into the root of a pine tree 2 feet in diameter, on the north side of the tree, toward the bridge, 60 feet distant from the south end of the bridge; elevation, 21.00 feet above the datum of the gage.

A description of this station, with gage height and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 57–59.

*Daily gage height, in feet, of Little Spokane River near Spokane, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 6.5 | 7.0 | 12 | 6.35 | 6.07 | 7.2 | 23 | 6.75 | 6.5 | 7.88 |
| 2 | 6.7 | 6.54 | 7.1 | 13 | 6.4 | 6.33 | 7.18 | 24 | 6.9 | 6.89 | 7.74 |
| 3 | 6.65 | 6.62 | 7.2 | 14 | 6.59 | 6.33 | 7.04 | 25 | 6.8 | 7.15 | 7.75 |
| 4 | 6.55 | 6.5 | 7.3 | 15 | 6.75 | 6.4 | 7.2 | 26 | 7.0 | 7.09 | 7.75 |
| 5 | 6.6 | 6.47 | 7.35 | 16 | 6.59 | 6.3 | 7.0 | 27 | 6.9 | 7.1 | 7.7 |
| 6 | 6.37 | 6.4 | 7.2 | 17 | 6.38 | 6.29 | 6.9 | 28 | 7.25 | 7.0 | 7.71 |
| 7 | 6.45 | 6.43 | 7.1 | 18 | 6.4 | 6.1 | 6.85 | 29 | 7.4 | ...... | 7.65 |
| 8 | 6.3 | 6.5 | 6.95 | 19 | 6.36 | 6.35 | 6.9 | 30 | 7.0 | ...... | 7.8 |
| 9 | 6.6 | 6.4 | 7.05 | 20 | 6.4 | 6.39 | 7.32 | 31 | 6.7 | ...... | 7.6 |
| 10 | 6.31 | 6.23 | 7.15 | 21 | 6.45 | 6.28 | 7.4 | | | | |
| 11 | 6.45 | 6.1 | 7.15 | 22 | 6.6 | 6.1 | 7.97 | | | | |

**Note.**—No ice record.

## OKANOGAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Okanogan River rises in Okanogan Lake, British Columbia, and flows southward, entering Columbia River near Brewster, Wash. Throughout its course in Canada the river flows through a chain-like series of lakes.

### SINLAHEKIN CREEK NEAR LOOMIS, WASH.

This station was established June 13, 1903, by Charles E. Hewitt, and was discontinued March 30, 1905. It is located on the main road between Loomis and Conconully, Wash., 3 miles from Loomis and 19 miles from Conconully.

The channel is straight for 20 feet above and for 50 feet below the station. Beyond these points are large bends in the stream. The right bank is low for about 15 feet back from the water's edge. Beyond this point it rises more abruptly and is not subject to overflow.

The water's edge is covered with shrubbery. The left bank is low grass land, subject to overflow. The bed of the stream is a gravelly clay or loam and is fairly stable.

Discharge measurements are made from a plank footbridge. The initial point for soundings is an iron bar driven flush with the ground at the northeast corner of the main part of Mr. R. A. Garrett's house.

The gage is a vertical staff driven into the ground and braced to the gatepost at the northeast corner of Mr. Garrett's yard. During 1905 the gage was read once each day by Mrs. Mary Garrett. The bench mark is the top of the iron bar used as the initial point for sounding: elevation, 11.40 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 100, p 394; 135, p 59.
**Discharge:** 100, p. 395
**Discharge, monthly:** 135, p 61.
**Gage heights:** 100, p 395; 135, p 60.
**Rating table:** 135, p 60.

*Daily gage height, in feet, of Sinlahekin Creek near Loomis, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. | Day. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.7 | 2.7 | 2.6 | 12 | 2.7 | 2.8 | 2.65 | 22 | 2.7 | 4.3 | 3.0 |
| 2 | 2.7 | 2.65 | 2.6 | 13 | 2.7 | 3.0 | 2.6 | 23 | 2.7 | 4.0 | 2.9 |
| 3 | 2.7 | 2.65 | 2.6 | 14 | 2.75 | 3.0 | 2.6 | 24 | 2.7 | 3.5 | 3.0 |
| 4 | 2.7 | 2.7 | 2.6 | 15 | 2.85 | 3.0 | 2.6 | 25 | 2.7 | 2.9 | 3.0 |
| 5 | 2.7 | 2.7 | 2.6 | 16 | 3.2 | 3.0 | 2.6 | 26 | 2.7 | 2.6 | 3.0 |
| 6 | 2.7 | 2.7 | 2.6 | 17 | 3.5 | 3.0 | 2.65 | 27 | 2.7 | 2.6 | 2.9 |
| 7 | 2.7 | 2.7 | 2.6 | 18 | 3.3 | 3.1 | 2.65 | 28 | 2.7 | 2.6 | 2.9 |
| 8 | 2.7 | 2.7 | 2.6 | 19 | 3.0 | 3.2 | 2.7 | 29 | 2.7 | ...... | 2.8 |
| 9 | 2.7 | 2.7 | 2.6 | 20 | 3.0 | 3.7 | 2.8 | 30 | 2.7 | ...... | 2.8 |
| 10 | 2.7 | 2.7 | 2.6 | 21 | 2.8 | 5.15 | 3.25 | 31 | 2.7 | ...... | 2.8 |
| 11 | 2.7 | 2.75 | 2.7 | | | | | | | | |

NOTE.—No ice record.

### SALMON CREEK NEAR MALOTT, WASH.

This station was established April 11, 1903, by T. A. Noble. It is located opposite R. D. Jones's house, which is on the county road halfway between Malott and Conconully, Okanogan County. It is reached by way of the Great Northern Railway to Wenache, thence by way of the Columbia River steamers to Brewster, and by the Conconully stage from Brewster to Jones's ranch.

The channel is straight for 100 feet above and 200 feet below the station. There are rapids at the bend in the river 100 feet above the station and at another bend 300 feet below the station. The current is swift. The right bank is low and will overflow for about 100 feet, at which point it becomes steep. The left bank is low and may overflow for 200 feet at extreme flood stages. Both banks are without trees or brush with the exception of a fringe of alder at the water's edge. The bed is rocky at the center and sandy along the banks. It is without vegetation except near the banks.

Discharge measurements are made from the footbridge. The initial point for soundings is a nail driven in a birch hub, 4 feet east of the bridge and 14 feet north of the gage. It is on the left bank, 7 feet from the water's edge at ordinary stages.

The gage is a vertical staff fastened to a small alder tree on the left bank of the river opposite the house of the observer, R. D. Jones, who during 1905 read the gage once each day. The bench mark is the initial point for soundings; elevation, 4.58 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey·

Description: 100, pp 389-390; 135, p 63
Discharge: 100, p 390; 135, p 64.
Discharge, monthly: 100, p 392; 135, p 65.
Gage heights: 100, p 391; 135, p 64.
Rating table: 100, p 391; 135, p 65.

*Discharge measurements of Salmon Creek near Malott, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 4 | O. Laurgaard | 28 | 82 | 4.43 | 2.67 | 362 |
| June 16 | do | 27 | 56 | 2.72 | 1.80 | 154 |
| July 27 | do | 25 | 34 | 1.22 | 1.10 | 41 |
| November 1 | do | 24 | 32 | .77 | .90 | 24 |

*Daily gage height, in feet, of Salmon Creek near Malott, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.69 | 0.73 | 0.94 | 0.98 | 1.67 | 2.18 | 1.81 | 0.99 | 0.93 | 0.75 | 0.88 | 0.61 |
| 2 | .77 | .74 | .96 | .96 | 1.62 | 2.25 | 1.94 | .96 | .9 | .73 | .82 | .67 |
| 3 | .71 | .74 | .99 | .94 | 1.66 | 2.3 | 1.91 | .94 | .96 | .75 | .79 | .69 |
| 4 | .72 | .75 | .99 | .9 | 1.6 | 2.83 | 1.88 | .92 | .83 | .75 | .81 | .7 |
| 5 | .75 | .77 | 1.0 | .97 | 1.67 | 2.46 | 1.75 | .92 | .82 | .88 | .81 | .71 |
| 6 | .77 | .75 | .99 | 1.08 | 1.71 | 2.43 | 1.69 | .88 | .75 | .92 | .79 | .75 |
| 7 | .75 | .73 | .97 | 1.10 | 1.75 | 2.33 | 1.62 | .83 | .73 | .98 | .78 | .75 |
| 8 | .73 | .71 | 1.0 | 1.12 | 1.91 | 2.24 | 1.58 | .81 | .73 | 1.0 | .77 | .75 |
| 9 | .71 | .67 | 1.01 | 1.15 | 1.92 | 2.34 | 1.54 | .79 | .74 | .88 | .76 | .74 |
| 10 | .67 | .65 | 1.02 | 1.17 | 1.96 | 2.31 | 1.5 | .77 | .74 | .83 | .75 | .72 |
| 11 | .68 | .66 | 1.04 | 1.19 | 1.88 | 2.27 | 1.48 | 1.12 | .73 | .83 | .77 | .73 |
| 12 | .71 | .67 | 1.05 | 1.2 | 1.75 | 2.24 | 1.46 | 1.11 | .73 | .81 | .79 | .74 |
| 13 | .72 | .69 | 1.07 | 1.21 | 1.75 | 2.06 | 1.45 | 1.12 | .74 | .77 | .77 | .75 |
| 14 | .74 | .68 | 1.08 | 1.19 | 1.71 | 1.97 | 1.44 | 1.1 | .79 | .75 | .76 | .75 |
| 15 | .75 | .67 | 1.1 | 1.18 | 1.69 | 1.91 | 1.44 | 1.1 | .81 | .83 | .75 | .74 |
| 16 | .76 | .66 | 1.1 | 1.25 | 1.68 | 1.83 | 1.43 | 1.08 | .79 | .79 | .76 | .75 |
| 17 | .77 | .71 | 1.12 | 1.38 | 1.75 | 1.79 | 1.38 | 1.08 | .81 | .81 | .77 | .76 |
| 18 | .77 | .67 | 1.12 | 1.35 | 1.69 | 1.76 | 1.33 | 1.08 | .79 | .79 | .79 | .77 |
| 19 | .78 | .72 | 1.14 | 1.38 | 1.67 | 1.77 | 1.29 | 1.06 | .71 | .83 | .83 | .75 |
| 20 | .78 | .73 | 1.12 | 1.6 | 1.62 | 1.79 | 1.27 | 1.04 | .69 | .85 | .75 | .75 |
| 21 | .79 | .77 | 1.1 | 1.64 | 1.6 | 1.83 | 1.25 | 1.02 | .69 | .81 | .62 | .7 |
| 22 | .8 | .78 | 1.09 | 1.67 | 1.61 | 1.85 | 1.17 | 1.0 | .69 | .79 | .61 | .54 |
| 23 | .82 | .82 | 1.1 | 1.71 | 1.71 | 1.71 | 1.12 | 1.0 | .67 | .79 | .62 | .58 |
| 24 | .83 | .83 | 1.1 | 1.88 | 1.73 | 1.88 | 1.08 | .99 | .64 | .83 | .6 | .62 |
| 25 | .83 | .83 | 1.12 | 2.0 | 1.85 | 1.92 | 1.08 | .99 | .69 | .85 | .58 | .67 |
| 26 | .84 | .85 | 1.1 | 2.04 | 1.83 | 2.08 | 1.0 | .96 | .83 | .9 | .57 | .73 |
| 27 | .81 | .84 | 1.09 | 1.93 | 1.83 | 2.12 | 1.04 | .96 | .81 | .83 | .5 | .73 |
| 28 | .79 | .85 | .92 | 1.88 | 1.88 | 2.09 | 1.08 | .92 | .88 | .81 | .5 | .74 |
| 29 | .79 | ....... | 1.07 | 1.81 | 1.88 | 1.94 | 1.08 | .94 | .83 | .75 | .54 | .72 |
| 30 | .77 | ....... | 1.05 | 1.74 | 1.91 | 1.88 | 1.04 | .92 | .79 | .64 | .55 | .71 |
| 31 | .73 | ....... | 1.02 | ....... | 2.0 | ....... | 1.0 | .92 | ....... | .71 | ....... | .7 |

NOTE.—No ice record.

*Station rating table for Salmon Creek near Malott, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 7 | 1.20 | 53 | 1.80 | 154 | 2.40 | 289 |
| 0.60 | 9 | 1.30 | 66 | 1.90 | 174 | 2.50 | 316 |
| 0.70 | 12 | 1.40 | 81 | 2.00 | 194 | 2.60 | 343 |
| 0.80 | 17 | 1.50 | 98 | 2.10 | 215 | 2.70 | 371 |
| 0.90 | 24 | 1.60 | 116 | 2.20 | 238 | 2.80 | 400 |
| 1.00 | 31 | 1.70 | 134 | 2.30 | 263 | 2.90 | 432 |
| 1.10 | 41 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is well defined between gage heights 0.8 foot and 2.6 feet.

*Estimated monthly discharge of Salmon Creek near Malott, Wash., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 20 | 11 | 15.0 | 922 |
| February | 20 | 10 | 14.1 | 783 |
| March | 46 | 25 | 36.3 | 2,232 |
| April | 202 | 24 | 87.5 | 5,207 |
| May | 194 | 116 | 146. | 8,977 |
| June | 410 | 134 | 215. | 12,790 |
| July | 182 | 31 | 85.4 | 5,251 |
| August | 43 | 16 | 30.3 | 1,863 |
| September | 28 | 10 | 16.2 | 964 |
| October | 31 | 10 | 18.3 | 1,125 |
| November | 23 | 7 | 13.7 | 815 |
| December | 16 | 8 | 12.8 | 787 |
| The year | 410 | 7 | 57.6 | 41,720 |

## METHOW RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Methow River has its source in the Cascade Mountains near the boundary line between the United States and British Columbia, and flows in a southeast direction into Columbia River. The stream is a very rapid one and is at present used to a considerable extent for irrigation purposes.

## METHOW RIVER NEAR PATEROS, WASH.

This station was originally established May 3, 1903, by T. A. Noble, and was located on a highway bridge about 1,000 feet above the mouth of the river. The first two measurements were taken from this bridge. During the summer of 1903 this bridge was washed away, and a temporary bridge 400 feet farther downstream was used in making the measurement of March 20, 1904.

During the spring of 1904 this bridge also was abandoned because of its temporary nature and the poor section at this point, and a cable station was established about a mile above the mouth of the river.

Both banks at the station are high and not liable to overflow. The bed of the stream is covered with small bowlders and gravel and is liable to changes. The section is good, except at the highest stage of the river. At such times the current at the station becomes too swift to measure, and it is necessary to use a boat farther down the stream, where the backwater from Columbia River retards the current.

The initial point for soundings is a cross marked "I. P." on rock about 10 feet back of the cable support on the left bank.

The gage is located about 500 feet below the cable, above any effect of backwater from Columbia River. It is fastened between two pine trees on the left bank. The lower section is inclined and reads from 0 to 10 feet. The upper section is vertical and reads from 10 to 19 feet. All gage heights given below and all discharge measurements are referred to this gage. A secondary gage is in place at the cable to be used by the hydrographer at the time of measurement, to assist in computing areas. During 1905 the gage was read once each day by K. K. Parker. Bench marks were established as follows: (1) A United States Gelogical Survey standard iron post in front of Ives Hotel, at Pateros, Wash.; elevation, 26.05 feet above zero of the gage and 780 feet above sea level. (2) The top of a large white stone, marked "B. M." which is 30 feet northeast of the gage board on the left bank; elevation, of the highest point, 15.20 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 387–388; 135, pp 65–66.
Discharge: 100, p 388; 135, p 66.
Discharge, monthly: 135, p 68.
Gage heights: 100, p 389; 135, p 67.
Rating table: 135, p 67.

*Discharge measurements of Methow River near Pateros, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 6 | O. Laurgaard | 178 | 730 | 4.27 | 6.50 | 3,116 |
| November 4 | do | 164 | 408 | 1.68 | 4.60 | 685 |
| November 28 | W. C. Sawyer | 155 | 380 | 1.62 | 4.30 | 618 |

*Daily gage height, in feet, of Methow River near Pateros, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.15 | 4.2 | 4.1 | 5.4 | 6.7 | 9.1 | 7.6 | 4.4 | 4.35 | 4.4 | 4.65 | 4.2 |
| 2 | 4.15 | 4.2 | 4.1 | 5.3 | 6.7 | 9.8 | 7.55 | 5.35 | 4.3 | 4.45 | 4.65 | 4.2 |
| 3 | 4.15 | 4.15 | 4.15 | 5.3 | 6.7 | 10.0 | 7.55 | 5.35 | 4.3 | 4.45 | 4.65 | 4.25 |
| 4 | 4.15 | 4.15 | 4.15 | 5.3 | 6.5 | 10.4 | 7.5 | 5.3 | 4.25 | 5.0 | 4.6 | 4.25 |
| 5 | 4.15 | 4.15 | 4.25 | 5.3 | 6.5 | 10.0 | 7.4 | 5.3 | 4.25 | 4.45 | 4.55 | 4.25 |
| 6 | 4.15 | 4.1 | 4.3 | 5.3 | 6.5 | 10.0 | 7.1 | 5.2 | 4.2 | 4.45 | 4.55 | 4.3 |
| 7 | 4.15 | 4.05 | 4.3 | 5.4 | 6.5 | 10.0 | 6.95 | 5.15 | 4.2 | 4.45 | 4.55 | 4.25 |
| 8 | 4.1 | 4.05 | 4.3 | 5.4 | 6.85 | 10.0 | 6.9 | 5.1 | 4.2 | 4.6 | 4.5 | 4.2 |
| 9 | 4.05 | 4.1 | 4.4 | 5.45 | 7.9 | 10.3 | 6.85 | 5.0 | 4.25 | 4.75 | 4.5 | 4.2 |
| 10 | 4.0 | 4.15 | 5.0 | 5.45 | 7.8 | 10.2 | 6.75 | 4.95 | 4.25 | 4.9 | 4.5 | 4.2 |
| 11 | 4.0 | 3.8 | 5.4 | 5.45 | 7.5 | 10.0 | 6.6 | 4.9 | 4.2 | 4.9 | 4.5 | 4.2 |
| 12 | 4.0 | 4.2 | 5.4 | 5.55 | 7.45 | 9.8 | 6.4 | 4.85 | 4.2 | 4.85 | 4.5 | 4.15 |
| 13 | 4.0 | 4.15 | 5.4 | 5.6 | 7.2 | 9.7 | 6.3 | 4.85 | 4.2 | 4.8 | 4.5 | 4.15 |
| 14 | 4.0 | 4.2 | 5.35 | 5.65 | 7.15 | 8.7 | 6.25 | 4.8 | 4.2 | 4.75 | 4.45 | 4.15 |
| 15 | 4.0 | 4.2 | 5.3 | 5.65 | 7.1 | 8.4 | 6.2 | 4.75 | 4.2 | 4.7 | 4.4 | 4.15 |
| 16 | 4.0 | 4.2 | 5.3 | 5.7 | 7.0 | 8.3 | 6.0 | 4.75 | 4.2 | 4.7 | 4.5 | 4.15 |
| 17 | 4.0 | 4.2 | 5.4 | 5.75 | 7.0 | 8.1 | 5.95 | 4.75 | 4.2 | 4.7 | 4.5 | 4.1 |
| 18 | 4.1 | 4.2 | 5.6 | 5.75 | 7.0 | 7.9 | 5.9 | 4.7 | 4.2 | 4.7 | 4.5 | 4.1 |
| 19 | 4.2 | 4.2 | 5.7 | 5.8 | 7.0 | 8.0 | 5.85 | 4.65 | 4.2 | 4.7 | 4.5 | 4.1 |
| 20 | 4.2 | 4.25 | 5.75 | 5.9 | 7.0 | 8.05 | 5.8 | 4.6 | 4.2 | 4.65 | 4.45 | 4.1 |
| 21 | 4.1 | 4.2 | 5.8 | 6.05 | 7.0 | 8.05 | 5.8 | 4.5 | 4.2 | 4.6 | 4.4 | 4.1 |
| 22 | 4.1 | 4.2 | 5.7 | 6.3 | 6.9 | 8.05 | 5.8 | 4.5 | 4.2 | 4.5 | 4.4 | 4.1 |
| 23 | 4.1 | 4.2 | 5.65 | 6.8 | 6.9 | 8.05 | 5.8 | 4.45 | 4.2 | 4.5 | 4.45 | 4.1 |
| 24 | 4.1 | 4.15 | 5.6 | 7.15 | 6.8 | 8.35 | 5.75 | 4.45 | 4.2 | 4.5 | 4.45 | 4.1 |
| 25 | 4.1 | 4.1 | 5.6 | 7.9 | 6.75 | 8.25 | 5.6 | 4.45 | 4.25 | 4.5 | 4.45 | 4.1 |
| 26 | 4.1 | 4.05 | 5.55 | 8.0 | 6.7 | 8.1 | 5.65 | 4.45 | 4.3 | 4.5 | 4.45 | 4.1 |
| 27 | 4.05 | 4.1 | 5.55 | 7.75 | 7.0 | 8.05 | 5.7 | 4.4 | 4.4 | 4.6 | 4.4 | 4.1 |
| 28 | 4.05 | 4.1. | 5.5 | 7.6 | 7.2 | 7.9 | 5.6 | 4.4 | 4.4 | 4.75 | 4.3 | 4.1 |
| 29 | 4.0 | ....... | 5.4 | 7.1 | 7.7 | 7.7 | 5.6 | 4.4 | 4.4 | 4.75 | 4.25 | 4.1 |
| 30 | 3.8 | ....... | 5.4 | 7.0 | 8.0 | 7.65 | 5.55 | 4.4 | 4.4 | 4.7 | 4.2 | 4.0 |
| 31 | 4.2 | ....... | 5.4 | ....... | 8.7 | ....... | 5.5 | 4.35 | ....... | 4.7 | ....... | 4.0 |

NOTE.—Some ice along shores during February.

*Station rating table for Methow River near Pateros, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.80 | 400 | 5.10 | 1,166 | 6.40 | 2,884 | 8.20 | 6,264 |
| 3.90 | 420 | 5.20 | 1,266 | 6.50 | 3,050 | 8.40 | 6,674 |
| 4.00 | 450 | 5.30 | 1,372 | 6.60 | 3,216 | 8.60 | 7,088 |
| 4.10 | 486 | 5.40 | 1,484 | 6.70 | 3,386 | 8.80 | 7,506 |
| 4.20 | 528 | 5.50 | 1,602 | 6.80 | 3,560 | 9.00 | 7,930 |
| 4.30 | 576 | 5.60 | 1,724 | 6.90 | 3,738 | 9.20 | 8,356 |
| 4.40 | 630 | 5.70 | 1,854 | 7.00 | 3,920 | 9.40 | 8,785 |
| 4.50 | 690 | 5.80 | 1,988 | 7.20 | 4,294 | 9.60 | 9,215 |
| 4.60 | 756 | 5.90 | 2,128 | 7.40 | 4,676 | 9.80 | 9,646 |
| 4.70 | 826 | 6.00 | 2,272 | 7.60 | 5,066 | 10.00 | 10,080 |
| 4.80 | 902 | 6.10 | 2,420 | 7.80 | 5,460 | 10.20 | 10,518 |
| 4.90 | 984 | 6.20 | 2,572 | 8.00 | 5,860 | 10.40 | 10,960 |
| 5.00 | 1,072 | 6.30 | 2,726 | | | | |

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1903-5. It is well defined.

*Estimated monthly discharge of Methow River near Pateros, Wash., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 528 | 400 | 480 | 29,510 |
| February | 552 | 400 | 506 | 28,100 |
| March | 1,988 | 486 | 1,291 | 79,380 |
| April | 5,860 | 1,372 | 2,517 | 149,800 |
| May | 7,296 | 3,050 | 4,110 | 252,700 |
| June | 10,960 | 5,164 | 7,749 | 461,100 |
| July | 5,066 | 1,602 | 2,839 | 174,600 |
| August | 1,428 | 603 | 899 | 55,280 |
| September | 630 | 528 | 553 | 32,910 |
| October | 1,072 | 630 | 792 | 48,700 |
| November | 791 | 528 | 678 | 40,340 |
| December | 576 | 450 | 507 | 31,170 |
| The year | 10,960 | 400 | 1,910 | 1,384,000 |

**Note.**—Discharge applied as for open channel during February.

## CHELAN RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

The Chelan is a short river, being only about 4 miles in length. It connects Lake Chelan with Columbia River, entering the latter at Chelan Falls. It is valuable principally for the water power that can be developed on it.

### LAKE CHELAN AT CHELAN, WASH.

A gage is attached to one of the bents of the upper bridge at Chelan, Wash. It is above the controlling dam and gives fluctuations of the lake surface only.

*Daily gage height, in feet, of Lake Chelan at Chelan, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | Day. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.4 | 2.25 | 1.8 | 2.18 | 3.05 | 4.0 | 17 | 2.37 | 1.8 | 2.2 | 2.05 | 3.25 | 5.7 |
| 2 | 2.45 | 2.25 | 1.85 | 2.15 | 3.05 | 4.35 | 18 | 2.37 | 1.8 | 2.25 | 2.1 | 3.25 | 5.6 |
| 3 | 2.45 | 2.2 | 1.9 | 2.1 | 3.0 | 4.8 | 19 | 2.37 | 1.8 | 2.25 | 2.1 | 3.25 | 5.5 |
| 4 | 2.45 | 2.2 | 2.0 | 2.1 | 2.9 | 4.95 | 20 | 2.3 | 1.8 | 2.3 | 2.1 | 3.25 | 5.45 |
| 5 | 2.4 | 2.19 | 2.1 | 2.05 | 2.9 | 5.35 | 21 | 2.35 | 1.8 | 2.3 | 2.15 | 3.25 | 5.4 |
| 6 | 2.38 | 2.0 | 2.2 | 2.0 | 2.9 | 5.45 | 22 | 2.33 | 1.8 | 2.3 | 2.2 | 3.25 | 5.4 |
| 7 | 2.4 | 1.95 | 2.0 | 2.0 | 2.95 | 5.5 | 23 | 2.32 | 1.7 | 2.3 | 2.3 | 3.2 | 5.35 |
| 8 | 2.48 | 1.9 | 2.05 | 2.0 | 3.0 | 5.6 | 24 | 2.35 | 1.8 | 2.32 | 2.4 | 3.15 | 5.3 |
| 9 | 2.47 | 1.9 | 2.1 | 2.0 | 3.0 | 5.8 | 25 | 2.48 | 1.8 | 2.35 | 2.55 | 3.15 | 5.3 |
| 10 | 2.45 | 1.9 | 2.05 | 1.95 | 3.15 | 5.0 | 26 | 2.4 | 1.8 | 2.32 | 2.8 | 3.1 | 5.28 |
| 11 | 2.42 | 1.85 | 2.15 | 1.95 | 3.25 | 6.1 | 27 | 2.35 | 1.85 | 2.3 | 2.95 | 3.15 | 5.25 |
| 12 | 2.4 | 1.85 | 2.25 | 2.05 | 3.25 | 6.25 | 28 | 2.3 | 1.8 | 2.3 | 3.0 | 3.2 | 5.2 |
| 13 | 2.4 | 1.8 | 2.25 | 1.98 | 3.3 | 6.25 | 29 | 2.3 | ...... | 2.25 | 3.05 | 3.3 | 5.1 |
| 14 | 2.38 | 1.8 | 2.3 | 2.0 | 3.25 | 6.15 | 30 | 2.28 | ...... | 2.2 | 3.1 | 3.5 | 5.0 |
| 15 | 2.37 | 1.8 | 2.2 | 2.0 | 3.27 | 6.0 | 31 | 2.25 | ...... | 2.2 | ...... | 3.8 | ...... |
| 16 | 2.35 | 1.8 | 2.2 | 2.0 | 3.25 | 5.9 | | | | | | | |

## CHELAN RIVER BELOW LAKE CHELAN, WASHINGTON.

This station was established November 6, 1903, by G. H. Bliss. It is located at the highway bridge 3,000 feet below the outlet of the lake and in the town of Chelan. A dam which has been constructed at the foot of the lake by the town of Chelan holds back the flow of water to some extent during the dry season. This dam is about 3,000 feet above the bridge.

The channel is straight for 50 feet above and 150 feet below the station. The right bank can not overflow. The left bank is lower than the right, but is not liable to overflow. Both banks are without trees. The bed of the stream is composed of rocks and gravel, free from vegetation, and liable to shift somewhat.

Discharge measurements are now made from the downstream side of the upper highway bridge. The initial point for soundings is the end vertical on the downstream side of the bridge at the northwest approach.

The gage is a vertical rod 16 feet long attached to the third pile bent of the northwestern approach to the bridge. During 1905 the gage was read once each day by G. L. Richardson. The bench mark is a wire spike driven into a root on the west side of a large cottonwood tree, which is 40 feet downstream from the northwestern approach to the bridge and 30 feet from the river; elevation, 11.86 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 387; 135, pp 68-69.
Discharge: 100, p 387; 135, p 69.
Discharge, monthly: 135, p 71.
Gage heights: 100, p 387; 135, pp 69-70.
Rating table: 135, p 70.

*Discharge measurements of Chelan River below Lake Chelan, Washington, in 1905.*

| Date. | Hydrographer. | Width. | Area of section | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 4 | O. Laurgaard | 285 | 943 | 4.04 | 7.68 | 3,810 |
| November 4 | do. | 295 | 1,129 | 1.09 | 6.20 | 1,230 |
| November 27 | W. C. Sawyer | 292 | 1,117 | .87 | 5.65 | 970 |

*Daily gage height, in feet, of Chelan River below Lake Chelan, Washington, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.4 | 5.3 | 5.4 | 6.75 | 7.8 | 8.9 | 9.5 | 8.0 | 5.9 | 6.2 | 6.3 | 5.55 |
| 2 | 5.4 | 5.3 | 5.4 | 6.7 | 7.8 | 9.2 | 9.43 | 7.9 | 5.85 | 6.23 | 6.25 | 5.6 |
| 3 | 5.45 | 5.3 | 5.43 | 6.65 | 7.75 | 9.4 | 9.38 | 7.8 | 5.85 | 6.35 | 6.25 | 5.6 |
| 4 | 5.4 | 5.29 | 5.48 | 6.65 | 7.65 | 9.6 | 9.35 | 7.7 | 5.8 | 6.55 | 6.2 | 5.6 |
| 5 | 5.4 | 5.29 | 5.52 | 6.62 | 7.65 | 9.85 | 9.3 | 7.6 | 5.78 | 6.6 | 6.15 | 5.55 |
| 6 | 5.4 | 5.5 | 5.56 | 6.6 | 7.65 | 9.95 | 9.28 | 7.55 | 5.8 | 6.7 | 6.13 | 5.5 |
| 7 | 5.4 | 5.45 | 5.57 | 6.6 | 7.7 | 10.0 | 9.22 | 7.5 | 5.85 | 6.9 | 6.1 | 5.5 |
| 8 | 5.38 | 5.45 | 6.15 | 6.6 | 7.75 | 10.1 | 9.15 | 7.55 | 5.9 | 6.8 | 6.1 | 5.5 |
| 9 | 5.38 | 5.45 | 6.18 | 6.6 | 7.75 | 10.2 | 9.1 | 7.5 | 6.0 | 6.75 | 6.1 | 5.5 |
| 10 | 5.37 | 5.45 | 6.5 | 6.58 | 7.9 | 10.35 | 9.05 | 7.4 | 6.1 | 6.6 | 6.05 | 5.5 |
| 11 | 5.37 | 5.4 | 6.6 | 6.58 | 8.0 | 10.45 | 9.0 | 7.35 | 6.12 | 6.65 | 6.0 | 5.45 |
| 12 | 5.37 | 5.4 | 6.65 | 6.65 | 8.0 | 10.6 | 8.95 | 7.3 | 6.15 | 6.7 | 5.98 | 5.4 |
| 13 | 5.37 | 5.4 | 6.65 | 6.6 | 8.05 | 10.6 | 8.9 | 7.3 | 6.18 | 6.75 | 5.9 | 5.5 |
| 14 | 5.35 | 5.38 | 6.75 | 6.6 | 8.0 | 10.55 | 8.8 | 7.25 | 6.2 | 6.6 | 5.88 | 5.5 |
| 15 | 5.35 | 5.4 | 6.8 | 6.6 | 8.02 | 10.4 | 8.7 | 7.15 | 6.2 | 6.55 | 5.85 | 5.5 |
| 16 | 5.35 | 5.4 | 6.8 | 6.6 | 8.0 | 10.3 | 8.6 | 6.6 | 6.15 | 6.5 | 5.9 | 5.5 |
| 17 | 5.38 | 5.4 | 6.8 | 6.65 | 8.0 | 10.15 | 8.5 | 6.6 | 6.15 | 6.48 | 5.8 | 5.5 |
| 18 | 5.38 | 5.4 | 6.9 | 6.7 | 8.0 | 10.05 | 8.37 | 5.7 | 6.1 | 6.4 | 5.8 | 5.5 |
| 19 | 5.32 | 5.4 | 6.9 | 6.7 | 8.0 | 10.0 | 8.25 | 5.75 | 6.05 | 6.38 | 5.9 | 5.45 |
| 20 | 5.32 | 5.4 | 6.95 | 6.7 | 8.0 | 9.95 | 8.2 | 5.75 | 6.0 | 6.32 | 5.9 | 5.4 |
| 21 | 5.33 | 5.4 | 6.95 | 6.77 | 8.0 | 9.9 | 8.17 | 5.75 | 6.1 | 6.1 | 5.85 | 5.4 |
| 22 | 5.33 | 5.4 | 6.95 | 6.85 | 8.0 | 9.85 | 8.2 | 5.78 | 6.1 | 6.25 | 5.8 | 5.4 |
| 23 | 5.32 | 5.37 | 6.95 | 7.0 | 8.0 | 9.85 | 8.25 | 5.78 | 6.1 | 6.2 | 5.7 | 5.4 |
| 24 | 5.32 | 5.4 | 7.03 | 7.1 | 7.95 | 9.8 | 8.25 | 5.8 | 6.2 | 6.25 | 5.65 | 5.4 |
| 25 | 5.35 | 5.4 | 7.03 | 7.3 | 7.9 | 9.8 | 8.25 | 5.8 | 6.2 | 6.2 | 5.7 | 5.4 |
| 26 | 5.32 | 5.4 | 7.02 | 7.6 | 7.85 | 9.78 | 8.25 | 5.85 | 6.18 | 6.25 | 5.8 | 5.6 |
| 27 | 5.33 | 5.4 | 7.0 | 7.7 | 7.9 | 9.75 | 8.22 | 5.8 | 6.18 | 6.35 | 5.7 | 5.5 |
| 28 | 5.32 | 5.4 | 7.0 | 7.75 | 7.95 | 9.7 | 8.2 | 5.8 | 6.2 | 6.3 | 5.65 | 5.45 |
| 29 | 5.32 | ....... | 6.9 | 7.8 | 8.05 | 9.6 | 8.17 | 5.8 | 6.2 | 6.3 | 5.6 | 5.4 |
| 30 | 5.3 | ....... | 6.8 | 7.85 | 8.2 | 9.58 | 8.15 | 6.0 | 6.2 | 6.35 | 5.6 | 5.4 |
| 31 | 5.3 | ....... | 6.8 | ....... | 8.6 | ....... | 8.1 | 5.9 | ....... | 6.3 | ....... | 5.4 |

NOTE.—No ice record.

*Station rating table for Chelan River below Lake Chelan, Washington, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.30 | 780 | 6.50 | 1,650 | 7.70 | 3,630 | 8.80 | 5,690 |
| 5.40 | 820 | 6.60 | 1,780 | 7.80 | 3,810 | 8.90 | 5,880 |
| 5.50 | 865 | 6.70 | 1,920 | 7.90 | 3,990 | 9.00 | 6,070 |
| 5.60 | 915 | 6.80 | 2,070 | 8.00 | 4,170 | 9.20 | 6,450 |
| 5.70 | 965 | 6.90 | 2,230 | 8.10 | 4,360 | 9.40 | 6,830 |
| 5.80 | 1,020 | 7.00 | 2,390 | 8.20 | 4,550 | 9.60 | 7,210 |
| 5.90 | 1,080 | 7.10 | 2,560 | 8.30 | 4,740 | 9.80 | 7,600 |
| 6.00 | 1,150 | 7.20 | 2,730 | 8.40 | 4,930 | 10.00 | 8,000 |
| 6.10 | 1,230 | 7.30 | 2,910 | 8.50 | 5,110 | 10.20 | 8,400 |
| 6.20 | 1,320 | 7.40 | 3,090 | 8.60 | 5,300 | 10.40 | 8,800 |
| 6.30 | 1,420 | 7.50 | 3,270 | 8.70 | 5,500 | 10.60 | 9,200 |
| 6.40 | 1,530 | 7.60 | 3,450 | | | | |

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904-5. It is fairly well defined between gage heights 5.6 feet and 10.3 feet.

*Estimated monthly discharge of Chelan River below Lake Chelan, Washington, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 842 | 780 | 803 | 49,380 |
| February | 865 | 776 | 817 | 45,370 |
| March | 2,441 | 820 | 1,809 | 111,200 |
| April | 3,900 | 1,754 | 2,239 | 133,200 |
| May | 5,300 | 3,540 | 4,049 | 249,000 |
| June | 9,200 | 5,880 | 7,887 | 469,300 |
| July | 7,020 | 4,360 | 5,471 | 336,400 |
| August | 4,170 | 965 | 2,180 | 134,000 |
| September | 1,320 | 1,009 | 1,207 | 71,820 |
| October | 2,230 | 1,230 | 1,608 | 98,870 |
| November | 1,508 | 915 | 1,115 | 66,350 |
| December | 915 | 820 | 856 | 52,630 |
| The year | 9,200 | 776 | 2,503 | 1,818,000 |

## WENATCHEE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Wenatchee River has its source on the eastern slope of the Cascade Mountains, and flows southeastward through Wenatchee Lake, entering Columbia River near Wenatchee, Wash.

### WENATCHEE RIVER AT CASHMERE, WASH.

This station was established July 26, 1904, by W. G. Steward. It is located at the highway bridge just north of the town of Cashmere, Wash.

The channel is curved for about 800 feet above and below the station, and the current is swift. The right bank is high, gravelly and rocky, lined with timber and bushes, and not liable to overflow. The left bank is not high, but overflows only in extremely high water. The bed of the stream is covered with small rounded bowlders and cobblestones, is free from vegetation, and permanent. The channel is divided by the pier into two channels. The bridge is located about midway of a long, sweeping curve. The water is swift, especially at the middle of the south span.

Discharge measurements are made from the downstream side of the two-span bridge to which the gage is attached. The initial point for soundings is a bolthead in the southeast corner of the bridge, marked zero.

A plain-staff gage is fastened to the downstream edge of the south face of the middle pier. During 1905 the gage was read once each day by A. C. Jones. Bench marks were established as follows: (1) The head of an 8-penny nail driven into a timber at the southeast corner of the middle pier; elevation, 12.98 feet. (2) A bolthead at the southeast corner of the bridge, identical with the initial point; elevation, 16.63 feet. (3) A railroad spike driven into a telephone pole at the left end of the bridge; elevation, 10.91 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 135, United States Geological Survey, pages 71–72.

*Discharge measurements of Wenatchee River at Cashmere, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| October 30 | W. G. Steward | 187 | 960 | 2.31 | 2.90 | 2,220 |
| November 3 | do | 185 | 894 | 2.23 | 2.48 | 1,993 |
| November 14 | do | 164 | 799 | 1.70 | 1.98 | 1,357 |
| November 25 | do | 162 | 784 | 1.55 | 1.87 | 1,214 |

*Daily gage height, in feet, of Wenatchee River at Cashmere, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.8 | 1.1 | 2.5 | 3.1 | 4.5 | 6.9 | 5.0 | 2.9 | 1.6 | 1.9 | 2.6 | 1.9 |
| 2 | 1.8 | 1.1 | 2.8 | 3.0 | 4.3 | 7.0 | 4.9 | 2.9 | 1.6 | 1.9 | 2.5 | 1.9 |
| 3 | 1.8 | 1.2 | 3.7 | 2.9 | 4.2 | 7.0 | 5.0 | 2.9 | 1.6 | 3.9 | 2.5 | 2.0 |
| 4 | 1.8 | 1.3 | 4.1 | 2.9 | 4.1 | 7.1 | 4.9 | 2.8 | 1.6 | 5.5 | 2.5 | 1.9 |
| 5 | 1.7 | 1.3 | 4.2 | 2.8 | 4.1 | 6.6 | 4.8 | 2.7 | 1.6 | 4.3 | 2.4 | 1.8 |
| 6 | 1.5 | 1.3 | 4.2 | 3.0 | 4.3 | 6.3 | 4.7 | 2.6 | 1.6 | 4.5 | 2.3 | 1.9 |
| 7 | 1.5 | 1.4 | 4.1 | 3.1 | 4.6 | 6.2 | 4.5 | 2.5 | 1.6 | 4.2 | 2.3 | 1.8 |
| 8 | 1.5 | 1.3 | 4.1 | 3.2 | 5.1 | 6.3 | 4.4 | 2.5 | 1.6 | 3.9 | 2.2 | 1.9 |
| 9 | 1.5 | 1.2 | 4.2 | 3.3 | 5.5 | 6.7 | 4.5 | 2.5 | 1.9 | 3.5 | 2.2 | 1.8 |
| 10 | 1.4 | 1.1 | 4.4 | 3.3 | 5.3 | 6.9 | 4.6 | 2.6 | 2.0 | 3.2 | 2.1 | 1.7 |
| 11 | 1.3 | 1.0 | 4.6 | 3.3 | 5.0 | 6.9 | 4.5 | 2.5 | 1.9 | 3.1 | 2.1 | 1.6 |
| 12 | 1.3 | 1.8 | 4.6 | 3.4 | 4.8 | 6.7 | 4.3 | 2.5 | 1.8 | 3.0 | 2.1 | 1.5 |
| 13 | 1.4 | 1.8 | 4.3 | 3.6 | 4.8 | 6.4 | 4.1 | 2.4 | 1.8 | 2.8 | 2.0 | 1.4 |
| 14 | 1.4 | 1.8 | 4.1 | 3.7 | 4.8 | 5.9 | 3.8 | 2.4 | 1.7 | 2.7 | 2.0 | 1.4 |
| 15 | 1.4 | 1.8 | 4.0 | 3.6 | 5.0 | 5.6 | 3.6 | 2.3 | 1.7 | 2.7 | 2.0 | 1.4 |
| 16 | 1.5 | 1.8 | 3.9 | 3.6 | 4.9 | 5.5 | 3.4 | 2.2 | 1.6 | 2.6 | 1.9 | 1.4 |
| 17 | 1.5 | 1.8 | 4.0 | 3.5 | 4.8 | 5.3 | 3.3 | 2.1 | 1.5 | 2.5 | 1.9 | 1.5 |
| 18 | 1.6 | 1.8 | 4.3 | 3.5 | 4.8 | 5.2 | 3.3 | 2.1 | 1.5 | 2.4 | 2.0 | 1.6 |
| 19 | 1.5 | 1.8 | 4.3 | 3.6 | 4.7 | 5.3 | 3.2 | 2.1 | 1.5 | 2.3 | 2.1 | 1.6 |
| 20 | 1.5 | 1.7 | 4.2 | 3.8 | 4.6 | 5.5 | 3.3 | 2.0 | 1.5 | 2.2 | 2.1 | 1.5 |
| 21 | 1.5 | 1.6 | 4.2 | 4.0 | 4.5 | 5.5 | 3.4 | 2.0 | 1.7 | 2.2 | 2.0 | 1.5 |
| 22 | 1.4 | 1.5 | 4.1 | 4.2 | 4.4 | 5.6 | 3.6 | 1.9 | 1.9 | 2.1 | 2.0 | 1.4 |
| 23 | 1.4 | 1.4 | 4.0 | 4.7 | 4.3 | 5.6 | 3.7 | 2.1 | 1.9 | 2.1 | 1.9 | 1.3 |
| 24 | 1.5 | 1.5 | 3.9 | 5.35 | 4.2 | 5.5 | 3.8 | 1.8 | 1.8 | 2.1 | 1.9 | 1.4 |
| 25 | 1.5 | 1.8 | 3.8 | 6.1 | 4.1 | 5.4 | 3.6 | 1.7 | 1.8 | 4.0 | 1.9 | 1.4 |
| 26 | 1.4 | 2.3 | 3.8 | 6.25 | 4.2 | 5.4 | 3.5 | 1.7 | 1.8 | 4.1 | 2.0 | 1.5 |
| 27 | 1.5 | 2.4 | 3.6 | 6.0 | 4.6 | 5.3 | 3.4 | 1.7 | 2.5 | 3.7 | 2.1 | 1.5 |
| 28 | 1.6 | 2.4 | 3.5 | 5.6 | 5.1 | 5.4 | 3.3 | 1.7 | 2.2 | 3.3 | 2.0 | 1.5 |
| 29 | 1.5 | ....... | 3.4 | 5.1 | 5.6 | 5.0 | 3.2 | 1.7 | 2.1 | 3.3 | 1.9 | 1.5 |
| 30 | 1.4 | ....... | 3.3 | 4.8 | 5.8 | 4.9 | 3.0 | 1.7 | 2.0 | 3.1 | 1.9 | 1.5 |
| 31 | 1.2 | ....... | 3.1 | ....... | 6.3 | ....... | 3.0 | 1.7 | ....... | 2.8 | ....... | 1.4 |

**NOTE.**—Ice conditions during part of January and February.

*Station rating table for Wenatchee River at Cashmere, Wash., from July 27, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 550 | 2.30 | 1,665 | 3.60 | 3,240 | 4.90 | 5,150 |
| 1.10 | 615 | 2.40 | 1,770 | 3.70 | 3,380 | 5.00 | 5,300 |
| 1.20 | 685 | 2.50 | 1,875 | 3.80 | 3,520 | 5.20 | 5,620 |
| 1.30 | 755 | 2.60 | 1,985 | 3.90 | 3,660 | 5.40 | 5,940 |
| 1.40 | 830 | 2.70 | 2,095 | 4.00 | 3,800 | 5.60 | 6,260 |
| 1.50 | 910 | 2.80 | 2,210 | 4.10 | 3,950 | 5.80 | 6,580 |
| 1.60 | 990 | 2.90 | 2,330 | 4.20 | 4,100 | 6.00 | 6,900 |
| 1.70 | 1,075 | 3.00 | 2,450 | 4.30 | 4,250 | 6.20 | 7,240 |
| 1.80 | 1,165 | 3.10 | 2,580 | 4.40 | 4,400 | 6.40 | 7,580 |
| 1.90 | 1,260 | 3.20 | 2,710 | 4.50 | 4,550 | 6.60 | 7,920 |
| 2.00 | 1,360 | 3.30 | 2,840 | 4.60 | 4,700 | 6.80 | 8,260 |
| 2.10 | 1,460 | 3.40 | 2,970 | 4.70 | 4,850 | 7.00 | 8,600 |
| 2.20 | 1,560 | 3.50 | 3,100 | 4.80 | 5,000 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 1.8 feet and 3.9 feet.

*Estimated monthly discharge of Wenatchee River at Cashmere, Wash., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| **1904.** | | | | |
| July 27-31 | 3,660 | 2,970 | 3,354 | 33,260 |
| August | 2,970 | 1,360 | 2,078 | 127,800 |
| September | 1,560 | 830 | 1,122 | 66,760 |
| October | 1,360 | 685 | 851 | 52,330 |
| November | 1,985 | 615 | 1,120 | 66,640 |
| December | 1,665 | 1,075 | 1,331 | 81,840 |
| The period | | | | 428,600 |
| **1905.** | | | | |
| January | 1,165 | 685 | 915 | 56,260 |
| February | 1,770 | 550 | 1,001 | 55,590 |
| March | 4,700 | 1,875 | 3,702 | 227,600 |
| April | 7,325 | 2,210 | 3,794 | 225,800 |
| May | 7,410 | 3,950 | 4,940 | 303,800 |
| June | 8,780 | 5,150 | 6,872 | 408,900 |
| July | 5,300 | 2,450 | 3,727 | 229,200 |
| August | 2,330 | 1,075 | 1,610 | 99,000 |
| September | 1,875 | 910 | 1,133 | 67,420 |
| October | 6,100 | 1,260 | 2,660 | 163,600 |
| November | 1,985 | 1,260 | 1,476 | 87,830 |
| December | 1,360 | 755 | 993 | 61,060 |
| The year | 8,780 | 550 | 2,735 | 1,986,000 |

NOTE.—Rating table applied as for open channel during entire year.

## YAKIMA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Yakima River has its source in Keechelus Lake, on the eastern slope of the Cascade Mountains, in Kittitas County, Wash. Within a short distance it receives the water of Kachess Lake, and 2½ miles above Clealum it receives the outlet of the last of the three large headwater lakes. Practically its entire summer flow is now used for irrigation. It enters Columbia River 5 miles above Kennewick, Wash.

Naches River has its source on the eastern slope of the Cascade Mountains, in Yakima County, Wash. It flows in a general southeasterly direction, entering Yakima River a short distance above North Yakima. Irrigation is practiced in the narrow valley along the lower course of the river, and its waters are of greater value for the irrigation of lands west of North Yakima. The river has considerable fall, and the water can easily be diverted by means of comparatively short canals.

Tieton River is the principal tributary of Naches River and discharges into the latter about 17 miles above its junction with Yakima River, near North Yakima. Its source is in the Cascade Mountains in the vicinity of Cowlitz Pass. A peculiar feature of the stream is the turbid, milk-white appearance of the water. It is similar in this respect to White River, on the western slope of the Cascade Range. The water of South Fork of the Tieton, 25 miles above the mouth, is, however, perfectly clear. The forks head in the glaciers of a peak of the Cascades known as Goat Rock.

### YAKIMA RIVER NEAR MARTIN, WASH.

Lake Keechelus is the uppermost of the three lakes forming the source of Yakima River. At the outlet a good dam site exists, and by the construction of a dam a considerable portion of the flow of the Yakima at this point can be stored and used for irrigation in the lower Yakima Valley during the dry season.

A gaging station was established October 18, 1903, by G. H. Bliss. It is 1,000 feet below the outlet of Lake Keechelus, 800 feet below the dam of the Cascade Lumber Company, and 4 miles northwest of Martin, Wash.

The channel is straight for 500 feet above and 350 feet below the station. Both banks are high, not liable to overflow, and heavily timbered. The current is swift, and there is but one channel at all stages. The bed of the stream is composed of gravel and is free from vegetation and permanent.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The cable has a total span of 200 feet. The initial point for soundings is the north face of the tree on the south (right) bank, to which the cable is fastened.

The original gage was in two sections and was located on the right bank just above the cable. The lower inclined section read from 5 to 7 feet. The upper vertical section read from 7 to 13 feet. Observations were taken daily from this gage until November 14, 1903, when the gage was destroyed by the caving of the river bank. Observations were then discontinued until January 28, 1904, when a new vertical gage, No. 2, was installed by the Yakima Development Company at a point 75 feet above the location of the old gage, and readings were resumed by the United States Geological Survey. The datum of this gage which is now in use is 0.07 foot higher than the original one. The gage is a vertical rod fastened to an overhanging tree. During 1905 the gage was read twice each day by Christian Hansen. Bench marks were established as follows: (1) The top of a spike in the root on the north side of a large cedar tree 50 feet south and 50 feet west of the gage; elevation, 21.59 feet. (2) A nail in the base of a 48-inch fir tree on the right bank 25 feet above the cable and 50 feet from the river; the tree is blazed and marked "B. M.;" elevation, 25.22 feet. Elevations refer to the datum of the present gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 100, p 386; 135, p 74.
**Discharge:** 100, p 386; 135, p 75.
**Discharge, monthly:** 135, p 76.
**Gage heights:** 135, p 75.
**Rating table:** 135, p 76.

*Discharge measurements of Yakima River near Martin, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 5 | W. J. Lightfoot | 120 | 344 | 2.46 | 8.60 | 846 |
| June 28 | do | 118 | 251 | 1.52 | 7.60 | 381 |
| August 25 | W. C. Muldrow | 105 | 130 | .59 | 6.50 | 75 |
| November 16 | do | 108 | 179 | .80 | 6.87 | 1,430 |

*Daily gage height, in feet, of Yakima River near Martin, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.1 | 6.8 | 7.5 | 7.3 | 7.9 | 8.8 | 7.4 | 6.6 | 6.4 | 6.91 | 7.34 | 7.24 |
| 2 | 7.2 | 6.8 | 7.8 | 7.2 | 7.8 | 8.75 | 7.4 | 6.6 | 6.4 | 7.15 | 7.28 | 7.22 |
| 3 | 7.2 | 6.8 | 7.9 | 7.1 | 7.7 | 8.85 | 7.3 | 6.6 | 6.42 | 7.94 | 7.23 | 7.2 |
| 4 | 7.1 | 6.75 | 8.0 | 7.1 | 7.7 | 8.65 | 7.3 | 6.55 | 6.42 | 8.28 | 7.23 | 7.14 |
| 5 | 7.1 | 6.75 | 8.2 | 7.1 | 7.6 | 8.45 | 7.3 | 6.5 | 6.4 | 8.32 | 7.19 | 7.12 |
| 6 | 7.0 | 6.75 | 8.25 | 7.1 | 7.7 | 8.35 | 7.2 | 6.5 | 6.39 | 8.37 | 7.14 | 7.12 |
| 7 | 7.0 | 6.78 | 8.2 | 7.2 | 7.8 | 8.3 | 7.15 | 6.5 | 6.4 | 8.23 | 7.10 | 7.1 |
| 8 | 6.9 | 6.8 | 8.1 | 7.2 | 8.1 | 8.3 | 7.1 | 6.5 | 6.4 | 8.17 | 7.06 | 7.08 |
| 9 | 6.9 | 6.8 | 8.15 | 7.2 | 8.3 | 8.3 | 7.1 | 6.5 | 6.4 | 8.09 | 7.04 | 7.04 |
| 10 | 6.8 | 6.8 | 8.25 | 7.2 | 8.2 | 8.25 | 7.1 | 6.5 | 6.4 | 7.94 | 7.01 | 7.02 |
| 11 | 6.8 | 6.75 | 8.3 | 7.2 | 8.1 | 8.2 | 7.1 | 6.5 | 6.39 | 7.82 | 7.0 | 6.98 |
| 12 | 6.8 | 6.7 | 8.3 | 7.25 | 8.0 | 8.1 | 7.0 | 6.4 | 6.39 | 7.71 | 6.94 | 6.96 |
| 13 | 6.8 | 6.65 | 8.15 | 7.3 | 8.0 | 8.0 | 7.0 | 6.4 | 6.42 | 7.62 | 6.92 | 6.92 |
| 14 | 6.8 | 6.65 | 8.0 | 7.4 | 8.25 | 7.9 | 6.9 | 6.4 | 6.4 | 7.56 | 6.9 | 6.9 |
| 15 | 6.8 | 6.65 | 7.9 | 7.4 | 8.4 | 7.8 | 6.9 | 6.5 | 6.4 | 7.52 | 6.89 | 6.88 |
| 16 | 6.8 | 6.6 | 7.9 | 7.4 | 8.3 | 7.7 | 6.9 | 6.5 | 6.4 | 7.46 | 6.87 | 6.86 |
| 17 | 6.8 | 6.6 | 7.9 | 7.4 | 8.3 | 7.6 | 6.9 | 6.55 | 6.42 | 7.44 | 6.85 | 6.92 |
| 18 | 6.7 | 6.6 | 7.9 | 7.4 | 8.2 | 7.6 | 6.8 | 6.6 | 6.43 | 7.4 | 6.88 | 6.94 |
| 19 | 6.7 | 6.6 | 7.9 | 7.5 | 8.1 | 7.55 | 6.8 | 6.6 | 6.42 | 7.32 | 6.9 | 6.92 |
| 20 | 6.7 | 6.6 | 7.9 | 7.65 | 8.0 | 7.5 | 6.8 | 6.6 | 6.44 | 7.26 | 6.98 | 6.9 |
| 21 | 6.7 | 6.7 | 7.9 | 7.8 | 7.9 | 7.5 | 6.8 | 6.6 | 6.43 | 7.22 | 6.94 | 6.86 |
| 22 | 6.7 | 6.7 | 7.9 | 7.9 | 7.9 | 7.45 | 6.8 | 6.5 | 6.44 | 7.17 | 6.92 | 6.85 |
| 23 | 6.7 | 6.7 | 7.9 | 8.15 | 7.9 | 7.4 | 6.7 | 6.5 | 6.5 | 7.11 | 6.9 | 6.86 |
| 24 | 6.8 | 6.8 | 7.9 | 8.45 | 7.95 | 7.4 | 6.7 | 6.5 | 6.5 | 7.26 | 6.88 | 6.85 |
| 25 | 6.8 | 6.9 | 7.8 | 8.75 | 8.05 | 7.4 | 6.7 | 6.5 | 6.52 | 8.04 | 6.9 | 6.88 |
| 26 | 6.8 | 7.1 | 7.7 | 8.8 | 8.1 | 7.4 | 6.7 | 6.5 | 6.74 | 8.09 | 6.96 | 6.93 |
| 27 | 6.8 | 7.2 | 7.6 | 8.7 | 8.1 | 7.45 | 6.7 | 6.5 | 6.84 | 7.97 | 7.02 | 6.95 |
| 28 | 6.8 | 7.2 | 7.6 | 8.5 | 8.4 | 7.5 | 6.7 | 6.5 | 6.87 | 7.82 | 7.16 | 6.94 |
| 29 | 6.9 | ....... | 7.5 | 8.25 | 8.5 | 7.5 | 6.7 | 6.5 | 6.9 | 7.72 | 7.32 | 6.92 |
| 30 | 6.8 | ....... | 7.4 | 8.0 | 8.5 | 7.5 | 6.6 | 6.5 | 6.91 | 7.56 | 7.31 | 6.9 |
| 31 | 6.8 | ....... | 7.3 | ....... | 8.9 | ....... | 6.6 | 6.4 | ....... | 7.44 | ....... | 6.88 |

NOTE.—No ice record.

*Station rating table for Yakima River near Martin, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.30 | 58 | 7.00 | 178 | 7.70 | 430 | 8.40 | 748 |
| 6.40 | 67 | 7.10 | 208 | 7.80 | 472 | 8.50 | 798 |
| 6.50 | 78 | 7.20 | 240 | 7.90 | 516 | 8.60 | 848 |
| 6.60 | 90 | 7.30 | 274 | 8.00 | 560 | 8.70 | 898 |
| 6.70 | 106 | 7.40 | 310 | 8.10 | 606 | 8.80 | 950 |
| 6.80 | 126 | 7.50 | 348 | 8.20 | 652 | 8.90 | 1,004 |
| 6.90 | 150 | 7.60 | 388 | 8.30 | 700 | 9.00 | 1,058 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905 It is well defined.

*Estimated monthly discharge of Yakima River near Martin, Wash., for 1905.*

[Drainage area, 56 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 240 | 106 | 143 | 8,793 | 2.55 | 2.94 |
| February | 240 | 90 | 124 | 6,887 | 2.21 | 2.30 |
| March | 700 | 274 | 522 | 32,100 | 9.32 | 10.74 |
| April | 950 | 208 | 419 | 24,930 | 7.48 | 8.34 |
| May | 1,004 | 388 | 603 | 37,080 | 10.77 | 12.42 |
| June | 977 | 310 | 534 | 31,780 | 9.54 | 10.64 |
| July | 310 | 90 | 169 | 10,390 | 3.02 | 3.48 |
| August | 90 | 67 | 79.7 | 4,901 | 1.42 | 1.64 |
| September | 153 | 66 | 80.9 | 4,814 | 1.44 | 1.61 |
| October | 734 | 153 | 430 | 26,440 | 7.68 | 8.85 |
| November | 288 | 138 | 191 | 11,360 | 3.41 | 3.80 |
| December | 254 | 138 | 173 | 10,640 | 3.09 | 3.56 |
| The year | 1,004 | 66 | 289 | 210,100 | 5.16 | 70.32 |

## YAKIMA RIVER NEAR NORTH YAKIMA, WASH.

This station was established May 5, 1904, by G. H. Bliss, and was discontinued October 15, 1905. It is located at the highway bridge at Selah Gap, 2½ miles north of North Yakima, Wash., one-fourth mile above the confluence of Yakima and Naches rivers, and 300 feet east of the bridge of the Northern Pacific Railway.

The channel is straight for about 800 feet above and 600 feet below the station. The current is sluggish at low stages. Both banks are low, partly wooded, and subject to overflow during high water. The bed of the stream is composed of gravel and sand, and is free from vegetation, and stable. There is one channel at all stages, broken by three bridge piers.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is a point marked zero on the top railing near the right end of the bridge, downstream side.

A staff gage is fastened vertically to the south side of the pier at the right end of the four-span highway bridge. During 1905 the gage was read once each day by Patrick Gallagher. The bench mark is the top of the shoe plate on the lower side of the bridge above the pier nearest the right bank; elevation, 16.64 feet above the datum of the gage.

A description of this station, with gage heights, discharge data, and rating table, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 79–81.

*Daily gage height, in feet, of Yakima River near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|
| 1 | ...... | 4.4 | 2.6 | 2.3 | ...... |
| 2 | 6.3 | ...... | 2.6 | 2.3 | 2.8 |
| 3 | 6.5 | 4.2 | 2.6 | 2.3 | 2.8 |
| 4 | ...... | 4.1 | 2.6 | 2.3 | 3.6 |
| 5 | 6.8 | 4.0 | 2.5 | 2.3 | 4.2 |
| 6 | 6.7 | 3.9 | 2.5 | 2.3 | 4.5 |
| 7 | 6.3 | 3.7 | 2.5 | 2.2 | 4.6 |
| 8 | 5.8 | 3.5 | 2.5 | 2.2 | ...... |
| 9 | 5.7 | 3.5 | 2.5 | 2.2 | 4.3 |
| 10 | 5.7 | 3.4 | 2.5 | 2.2 | 4.0 |
| 11 | ...... | 3.4 | 2.5 | 2.2 | 4.0 |
| 12 | 5.6 | 3.3 | 2.5 | 2.2 | 3.9 |
| 13 | 5.4 | 3.2 | ...... | 2.3 | 3.8 |
| 14 | 5.2 | 3.0 | 2.4 | 2.3 | 3.8 |
| 15 | 4.9 | 3.0 | 2.4 | 2.3 | ...... |
| 16 | 4.8 | 3.0 | 2.4 | 2.2 | ...... |
| 17 | 4.7 | 3.0 | 2.4 | ...... | ...... |
| 18 | ...... | 2.9 | 2.4 | 2.2 | ...... |
| 19 | 4.4 | 2.9 | 2.4 | 2.2 | ...... |
| 20 | 4.2 | 2.8 | 2.3 | 2.2 | ...... |
| 21 | 4.2 | 2.8 | 2.3 | 2.2 | ...... |
| 22 | 4.2 | 2.8 | 2.3 | 2.3 | ...... |
| 23 | 4.3 | 2.75 | 2.3 | 2.3 | ...... |
| 24 | 4.3 | 2.7 | 2.3 | ...... | ...... |
| 25 | ...... | 2.7 | 2.3 | 2.3 | ...... |
| 26 | 4.3 | 2.7 | 2.3 | 2.4 | ...... |
| 27 | 4.3 | 2.7 | ...... | 2.4 | ...... |
| 28 | 4.9 | 2.7 | 2.3 | 2.5 | ...... |
| 29 | 4.7 | 2.7 | 2.3 | 2.6 | ...... |
| 30 | 4.6 | 2.65 | 2.3 | 2.8 | ...... |
| 31 | ...... | 2.6 | 2.3 | ...... | ...... |

## YAKIMA RIVER NEAR YAKIMA, WASH.

Yakima River enters Columbia River just above the town of Pasco. The first measurement of the river was made at this point August 14, 1893. The station was originally located at the county bridge at Union Gap, 2 miles below Yakima, Wash. The station was reestablished in August, 1895, a cable and new gage being installed about 1,000 feet below the bridge. It is about 3 miles above the intake of the Sunnyside canal. The station is of value, as it is the only point near the large irrigated area above and below which is unaffected by the taking out of water in irrigating canals.

The channel is straight for 1,000 feet above and below the station. The current has a moderate velocity. The right bank is high, not liable to overflow, and is covered with sagebrush. The left bank is a low gravel bar which overflows during extreme high water. The bed of the stream is composed of gravel and is free from vegetation and permanent. There is one channel at low water and two channels at ordinary and flood stages.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is a cross chiseled on a rock 2.7 feet from the cable support on the right bank.

The present gage is an inclined rod attached to a willow stump and post set in the ground. During 1905 the gage was read once each day by Hugh Kennedy. Bench marks were established as follows: (1) The top of a large bowlder between two other bowlders 43 feet north of the gage and 6.5 feet east of the fence; elevation, 17.52 feet. (2) The top of a large bowlder under the railroad fence 12 feet north of the gage; elevation, 21.29 feet. (3) The initial point for soundings; elevation, 17.45 feet. The bench marks are marked "B. M." with black paint. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 14, ii, pp 133–134; 18, iv, pp 356–357; 19, iv, p 479; Bull 140, pp 245–246; WS 16, p 175; 28, p 159; 38, pp 373–374; 51, p 441; 66, p 135; 85, pp 188–189; 100, pp 376–377; 135, pp 81–82.

Discharge. Ann 14, ii, p 134; 18, iv, p 357; 19, iv, p 480; Bull 131, pp 90, 92; 140, p 246; WS 16, p 175; 28, p 169; 38, p 374; 51, p 441; 85, p 189; 100, p 377; 135, p 83.

**Discharge, monthly:** Ann 18, iv, p 358; 19, iv, p 480; 20, iv, pp 499, 500; 21, iv, p 427; 22, iv, p 447; WS p 75, 202; 85, p 190; 100, p 378; 135, p 84.

**Discharge, yearly:** Ann 20, iv, p 62.

**Gage heights:** Bull 140, p 247; WS 11, p 85; 16, p 175; 28, p 165; 38, p 374; 51, p 442; 66, p 135; 85, p 189; 100, p 377; 135, p 83.

**Hydrographs:** Ann 19, iv, pp 480, 481; 20, iv, p 501; 21, iv, p 428; 22, iv, p 447.

**Rainfall and run-off relation:** Ann 20, iv, p 500.

**Rating tables:** Ann 18 iv, p. 357; 19, iv, p. 479; WS 28, p. 170; 30, p. 451; 52, p. 522; 66, p. 177; 85, p 190; 100, p 378; 135, p 84.

*Discharge measurements of Yakima River near Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 19 | W. J. Lightfoot | 236 | 1,344 | 2.92 | 6.10 | 3,922 |
| September 2 | W. C. Muldrow | 230 | 753 | 1.04 | 3.64 | 780 |
| October 26 | do | 240 | 1,250 | 2.85 | 5.60 | 3,567 |
| November 18 | Sawyer and Muldrow | 238 | 960 | 1.67 | 4.32 | 1,600 |

*Daily gage height, in feet, of Yakima River near Yakima, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.0 | 4.3 | 6.0 | 6.0 | 6.9 | 7.7 | 6.5 | 4.1 | 3.6 | 4.1 | 5.1 | 4.7 |
| 2 | 5.0 | 4.4 | 6.8 | 5.9 | 6.5 | 7.9 | 6.4 | 4.1 | 3.6 | 4.15 | 5.0 | 4.7 |
| 3 | 5.0 | 4.5 | 7.2 | 5.8 | 6.1 | 8.3 | 6.3 | 4.1 | 3.6 | 4.15 | 4.9 | 4.6 |
| 4 | 5.0 | 4.6 | 7.8 | 5.8 | 6.0 | 9.1 | 6.3 | 4.0 | 3.6 | 5.1 | 4.9 | 4.65 |
| 5 | 4.9 | 4.5 | 7.8 | 5.9 | 6.0 | 8.8 | 6.0 | 4.0 | 3.6 | 5.8 | 4.8 | 4.7 |
| 6 | 4.9 | 4.4 | 7.9 | 5.9 | 6.0 | 8.3 | 6.0 | 4.0 | 3.65 | 6.4 | 4.8 | 4.7 |
| 7 | 4.9 | 4.5 | 7.9 | 6.0 | 6.1 | 8.0 | 5.9 | 3.9 | 3.68 | 6.45 | 4.7 | 4.7 |
| 8 | 4.9 | 4.6 | 7.9 | 6.0 | 6.3 | 7.8 | 5.7 | 3.9 | 3.68 | 6.4 | 4.7 | 4.75 |
| 9 | 4.9 | 4.6 | 7.7 | 5.9 | 6.4 | 7.6 | 5.4 | 3.8 | 3.62 | 6.0 | 4.6 | 4.65 |
| 10 | 4.8 | 4.5 | 7.9 | 5.8 | 7.0 | 7.6 | 5.3 | 3.8 | 3.62 | 5.9 | 4.6 | 4.5 |
| 11 | 4.6 | 4.4 | 7.9 | 5.8 | 7.0 | 7.6 | 5.3 | 3.7 | 3.68 | 5.8 | 4.6 | 4.45 |
| 12 | 4.4 | 4.0 | 7.8 | 5.9 | 6.7 | 7.5 | 5.1 | 3.7 | 3.7 | 5.8 | 4.55 | 4.45 |
| 13 | 4.4 | 3.9 | 7.9 | 5.9 | 6.5 | 7.5 | 5.1 | 3.7 | 3.7 | 5.8 | 4.5 | 4.45 |
| 14 | 4.4 | 3.9 | 7.9 | 6.1 | 6.3 | 7.3 | 4.9 | 3.7 | 3.8 | 5.4 | 4.5 | 4.4 |
| 15 | 4.2 | 3.9 | 7.6 | 6.2 | 6.4 | 7.2 | 4.9 | 3.6 | 3.75 | 5.3 | 4.4 | 4.4 |
| 16 | 4.4 | 3.8 | 7.3 | 6.1 | 6.6 | 6.9 | 4.7 | 3.6 | 3.7 | 5.2 | 4.4 | 4.3 |
| 17 | 4.6 | 3.8 | 7.3 | 6.0 | 6.7 | 6.5 | 4.6 | 3.6 | 3.7 | 5.15 | 4.35 | 4.3 |
| 18 | 4.7 | 3.8 | 7.3 | 6.0 | 6.6 | 6.5 | 4.6 | 3.6 | 3.72 | 5.0 | 4.35 | 4.35 |
| 19 | 4.7 | 3.9 | 7.4 | 6.0 | 6.6 | 6.4 | 4.5 | 3.6 | 3.7 | 5.0 | 4.4 | 4.3 |
| 20 | 4.7 | 4.0 | 7.5 | 6.0 | 6.5 | 6.3 | 4.4 | 3.6 | 3.7 | 4.9 | 4.45 | 4.3 |
| 21 | 4.7 | 4.9 | 7.4 | 5.9 | 6.4 | 6.3 | 4.4 | 3.7 | 3.72 | 4.9 | 4.45 | 4.35 |
| 22 | 4.6 | 5.2 | 7.3 | 6.0 | 6.2 | 6.3 | 4.4 | 3.6 | 3.8 | 4.8 | 4.4 | 4.35 |
| 23 | 4.6 | 5.5 | 7.2 | 6.3 | 6.2 | 6.3 | 4.3 | 3.6 | 3.8 | 4.7 | 4.4 | 4.3 |
| 24 | 4.7 | 5.5 | 7.2 | 6.8 | 6.2 | 6.3 | 4.4 | 3.6 | 3.8 | 4.7 | 4.4 | 4.3 |
| 25 | 4.7 | 5.4 | 7.1 | 7.4 | 6.2 | 6.4 | 4.3 | 3.6 | 3.8 | 4.7 | 4.3 | 4.35 |
| 26 | 4.7 | 5.4 | 7.0 | 7.8 | 6.1 | 6.7 | 4.2 | 3.6 | 3.8 | 5.0 | 4.4 | 4.4 |
| 27 | 4.8 | 5.4 | 6.9 | 8.0 | 6.1 | 7.0 | 4.3 | 3.6 | 3.78 | 5.8 | 4.5 | 4.4 |
| 28 | 4.9 | 5.9 | 6.6 | 7.9 | 6.4 | 6.9 | 4.2 | 3.6 | 3.9 | 5.8 | 4.6 | 4.3 |
| 29 | 4.8 | ....... | 6.4 | 7.3 | 6.7 | 6.7 | 4.2 | 3.6 | 4.0 | 5.7 | 4.7 | 4.3 |
| 30 | 4.7 | ....... | 6.3 | 7.0 | 6.7 | 6.7 | 4.2 | 3.6 | 4.0 | 5.6 | 4.7 | 4.2 |
| 31 | 4.5 | ....... | 6.3 | ....... | 7.4 | ....... | 4.1 | 3.6 | ....... | 5.2 | ....... | 4.2 |

## YAKIMA RIVER AT PROSSER, WASH.

This station was established May 30, 1904, by G. H. Bliss. It is located at the highway bridge 600 feet below Prosser Falls at Prosser, Wash.

The channel is straight for about 100 feet above and 600 feet below the station. The current above the station is swift, the foot of the rapids being 150 feet above. The current below the station is sluggish at ordinary and swift at higher stages. Both banks are high and not subject to overflow. The bed of the stream is composed of rock and is free from vegetation and permanent. There are large bowlders in the channel. There is but one channel at all stages, broken by the trestle bents on either side during the higher stages.

Discharge measurements are made from the downstream side of the bridge, which has a single span with trestle approach at either end. The initial point for soundings is a nail driven into the downstream guard rail 30 feet from the right bank.

A standard chain gage is attached to the upstream side of the bridge near the right bank; length of the chain, 28.06 feet. During 1905 the gage was read once each day by J. N. Jacoby. Bench marks were established as follows: (1) A spike in a sill on the east end of the pump of the Prosser Irrigation Company's canal; elevation, 13.87 feet. (2) A spike on an upright bridge timber 20 feet south of the steel and concrete pier on the south bank; elevation, 11.42 feet. (3) The top of the steel cylinder of the concrete pier at the right bank, upstream side; elevation, 23.92 feet. Elevations refer to the datum of the gage.

A description of this station, with gage heights, discharge data, and rating table is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 85–87.

*Discharge measurements of Yakima River at Prosser, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 17 | Bliss and Muldrow | | | | 0.55 | [a] 194 |
| September 1 | G. H. Bliss | | | | .43 | [a] 176 |
| October 22 | W. C. Muldrow | 130 | 1,102 | 1.77 | 3.76 | [b] 1,950 |

[a] Discharge of river is found by adding the sum of the measured discharges of the power flumes to the estimated discharge of the river below the dam and subtracting the discharge of the pumps:

| | Aug. 17. | Sept. 1. |
|---|---|---|
| Prosser flume | 185 | 105 |
| Taylor flume | 0 | 58 |
| Estimated for river | 20 | 20 |
| | 205 | 183 |
| Discharge of pumps | 9 | 7 |
| Flow at gage | 194 | 176 |

[b] Measured at the bridge.

*Daily gage height, in feet, of Yakima River at Prosser, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | ........ | 5.76 | 1.76 | 0.43 | 1.93 | 4.26 | 3.93 |
| 2 | ........ | 5.6 | 1.68 | .51 | 1.76 | 4.43 | 3.85 |
| 3 | ........ | 5.51 | 1.68 | .51 | 2.01 | 4.43 | 3.85 |
| 4 | ........ | 5.43 | 1.6 | .51 | 2.51 | 4.18 | 3.85 |
| 5 | ........ | 5.18 | 1.51 | .55 | 3.93 | 4.1 | 3.76 |
| 6 | ........ | 4.93 | 1.43 | .51 | 5.1 | 4.1 | 3.85 |
| 7 | ........ | 4.6 | 1.43 | .51 | 5.43 | 3.93 | 3.76 |
| 8 | 7.81 | 4.43 | 1.35 | .55 | 5.6 | 3.76 | 3.68 |
| 9 | 7.68 | 4.18 | 1.26 | .68 | 5.26 | 3.76 | 3.68 |
| 10 | 7.68 | 3.93 | 1.1 | .68 | 5.01 | 3.68 | 3.68 |
| 11 | 7.77 | 3.76 | .93 | .68 | 4.85 | 3.6 | 3.6 |
| 12 | 7.81 | 3.43 | .76 | .85 | 4.6 | 3.6 | 3.51 |
| 13 | 7.43 | 3.3 | .6 | 1.26 | 4.43 | 3.68 | 3.43 |
| 14 | 7.18 | 3.3 | .51 | 1.01 | 4.26 | 3.68 | 3.35 |
| 15 | 6.93 | 3.1 | .51 | 1.18 | 4.18 | 3.6 | 3.26 |
| 16 | 6.35 | 2.93 | .51 | 1.26 | 4.01 | 3.6 | 3.43 |
| 17 | 6.18 | 2.8 | .51 | 1.01 | 3.93 | 3.68 | 3.43 |
| 18 | 6.75 | 2.68 | .51 | 1.26 | 3.85 | 3.51 | 3.51 |
| 19 | 5.68 | 2.6 | .51 | 1.26 | 3.85 | 3.43 | 3.51 |
| 20 | 5.6 | 2.43 | .51 | 1.26 | 3.76 | 3.43 | 3.51 |
| 21 | 5.64 | 2.18 | .51 | 1.35 | 3.68 | 3.51 | 3.43 |
| 22 | 5.51 | 2.43 | .51 | 1.35 | 3.76 | 3.51 | 3.43 |
| 23 | 5.51 | 2.1 | .47 | 1.35 | 3.68 | 3.51 | 3.35 |
| 24 | 5.6 | 2.18 | .51 | 1.6 | 3.43 | 3.43 | 3.35 |
| 25 | 5.6 | 2.1 | .55 | 1.51 | 3.51 | 3.43 | 3.18 |
| 26 | 5.6 | 1.93 | .55 | 1.51 | 3.60 | 3.43 | 3.18 |
| 27 | 5.68 | 1.85 | .51 | 1.68 | 4.93 | 3.51 | 3.1 |
| 28 | 6.1 | 1.85 | .81 | 1.76 | 5.01 | 3.76 | 3.18 |
| 29 | 6.18 | 1.85 | .43 | 1.93 | 4.76 | 3.93 | 3.35 |
| 30 | 6.01 | 1.85 | .43 | 1.93 | 4.68 | 3.93 | 3.43 |
| 31 | ........ | 1.68 | .43 | ........ | 4.43 | ........ | ........ |

NOTE.—Low-water estimates for this station may be obtained by taking the sum of the flow of Yakimà River at Kiona; the Kiona Canal and Kiona Water-Supply Canal.

## YAKIMA RIVER AT KIONA, WASH.

This station was established August 20, 1895. It is located at the highway bridge on the county road about 1,800 feet northwest of the Northern Pacific Railway station at Kiona, Wash. It is about 23 miles above the mouth of the river.

The channel is straight for 500 feet above and 400 feet below the station. The current has a moderate velocity. The right bank is low, but is well protected by a levee and is not subject to overflow. The bed of the stream is composed of fine gravel, not subject to change. At low water the river flows beneath the middle main span; at high water it passes under an additional shorter span at each end of the bridge.

Discharge measurements are made from the upstream side of the bridge, to which the gage is attached. There is a stay wire 70 feet above the bridge. The initial point for soundings is a point on the west side of the bridge 100 feet south of the center of the south pier of the main span.

The original gage consisted of an inclined and a vertical section, spiked to the east end of the south pier of the bridge and anchored with rocks. The gage used during 1905 up to December 23 was of the wire type, and was located on the downstream side of the bridge between the fifth and seventh verticals from the right bank; length of the wire, 27.21 feet. The distance from the end of the scale board to the outside edge of the pulley was 2.00 feet.

December 23, 1905, a staff gage was installed, consisting of a vertical section bolted to the downstream side of the pier near the right bank and an inclined section at the foot of the pier. During 1905 the gage was read once each day by H. A. Shandy. Bench marks were established as follows: (1) The top of a spike in the east end of the cap of the first trestle bent on the right bank; elevation, 20.94 feet. (2) A spike on the north side of the stay-wire post on the right bank; elevation, 18.73 feet. (3) A nail in the upstream end of the first trestle bent on the left bank; elevation, 18.73 feet. Elevations refer to the datum of the gage. The United States Geological Survey standard iron bench-mark post, near the Northern Pacific Railway station, has an elevation above sea level of 515 feet, 62.00 feet above the datum of the gage. All bench marks are marked "B. M." with black paint.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann = Annual Report; Bull = Bulletin; WS = Water-Supply Paper):

Description: Ann 18, iv, p 358; 19, iv, p 481; Bull 140, p 248; WS 16, p 176; 28, p 159; 38, p 375; 51, p 442; 66, p 136; 85, p 186; 100, pp 373–374; 135, pp 87–88.

Discharge: Ann 18, iv, p 358; 19, iv, p 483; Bull 140, p 248; WS 16, p 176; 28, p 169; 38, p 375; 51, p 442; 66, p 136; 85, p 186; 100, p 374; 135, p 88.

Discharge, monthly: Ann 18, iv, p 359; 19, iv, p 485; 20, iv, pp 499, 502; 21, iv, p 428; 22, iv, p 448; WS 75, p 203; 85, p 188; 100, p 375; 135, p 89.

Discharge, yearly: Ann 20, iv, p 62.

Gage heights: Bull 140, p 249; WS 11, p 83; 16, p 176; 28, p 165; 38, p 375; 51, p 443; 66, p 136; 85, p 187; 100, p 374; 135, p 88.

Hydrographs: Ann 19, iv, p 486; 20, iv, p 502; 21, iv, p 429; 22, iv, p 448; WS 75, p 203.

Rainfall and run-off relation: Ann 20, iv, p 500.

Rating tables: Ann 18, iv, p 359; 19, iv, p 484; WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 85, p 187; 100, p 375; 135, p 89.

*Discharge measurements of Yakima River at Kiona, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 10 | W. J. Lightfoot | 253 | 1,527 | 3.49 | 7.50 | 5,327 |
| June 12 | .....do | 298 | 2,008 | 4.67 | 8.80 | 9,377 |
| August 24 | W. C. Muldrow | 62 | 70 | 2.63 | 2.60 | 183 |
| September 14 | Frank Halfpenny | 205 | 531 | .57 | 2.90 | 305 |
| September 14[a] | .....do | 125 | 128 | 2.26 | 2.90 | 290 |
| October 19 | W. C. Muldrow | 217 | 1,063 | 2.19 | 5.15 | 2,337 |
| October 22 | .....do | 130 | 1,102 | 1.77 | 4.76 | 1,950 |
| November 22 | Muldrow and Sawyer | 248 | 1,008 | 1.89 | 5.05 | 1,905 |

[a] Made above rapids.

*Daily gage height, in feet, of Yakima River at Kiona, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.81 | 4.9 | 6.65 | 6.9 | 7.5 | 8.2 | 6.8 | 3.35 | 2.4 | 3.7 | 5.6 | 5.3 |
| 2 | 5.65 | 4.85 | 7.0 | 6.7 | 7.2 | 8.9 | 6.7 | 3.3 | 2.45 | 3.75 | 5.5 | 5.3 |
| 3 | 5.6 | 4.8 | 7.62 | 6.6 | 6.8 | 9.3 | 6.6 | 3.35 | 2.45 | 3.8 | 5.4 | 5.3 |
| 4 | 5.55 | 4.85 | 8.48 | 6.4 | 6.5 | 9.9 | 6.4 | 3.25 | 2.4 | 3.9 | 5.4 | 5.3 |
| 5 | 5.55 | 4.9 | 8.95 | 6.2 | 6.4 | 10.4 | 6.1 | 3.2 | 2.4 | 4.7 | 5.3 | 5.3 |
| 6 | 5.56 | 4.9 | 9.25 | 6.1 | 6.3 | 9.9 | 6.0 | 3.2 | 2.45 | 5.75 | 5.3 | 5.2 |
| 7 | 5.4 | 4.85 | 9.38 | 6.0 | 6.2 | 9.5 | 5.8 | 3.1 | 2.5 | 6.6 | 5.2 | 5.15 |
| 8 | 5.4 | 4.8 | 9.25 | 6.3 | 6.3 | 9.0 | 5.5 | 3.0 | 2.55 | 6.7 | 5.15 | 5.15 |
| 9 | 5.48 | 4.82 | 9.1 | 6.2 | 6.8 | 8.6 | 5.3 | 3.0 | 2.7 | 6.8 | 5.15 | 5.1 |
| 10 | 5.2 | 4.65 | 9.2 | 6.3 | 7.5 | 8.8 | 5.1 | 2.8 | 2.8 | 6.2 | 5.2 | 5.1 |
| 11 | 5.1 | 4.7 | 9.3 | 6.3 | 7.5 | 8.9 | 5.0 | 2.7 | 2.8 | 6.0 | 5.15 | 5.05 |
| 12 | 4.4 | 4.3 | 9.45 | 6.2 | 7.3 | 8.8 | 4.9 | 2.5 | 2.8 | 5.7 | 5.1 | 5.05 |
| 13 | 4.4 | 4.48 | 9.4 | 6.15 | 6.4 | 8.3 | 4.8 | 2.7 | 2.85 | 5.6 | 5.1 | 5.0 |
| 14 | 4.5 | 4.25 | 9.15 | 6.3 | 6.7 | 7.9 | 4.7 | 2.6 | 2.85 | 5.4 | 5.1 | 5.0 |
| 15 | 5.0 | 4.45 | 8.8 | 6.5 | 6.6 | 7.7 | 4.65 | 2.5 | 2.9 | 5.4 | 5.05 | 5.0 |
| 16 | 5.0 | 4.5 | 8.55 | 6.5 | 6.8 | 7.4 | 4.5 | 2.4 | 3.0 | 5.35 | 5.0 | 5.0 |
| 17 | 5.2 | 4.6 | 8.6 | 6.4 | 7.0 | 7.1 | 4.2 | 2.4 | 3.0 | 5.3 | 4.9 | 5.0 |
| 18 | 5.2 | 4.6 | 8.65 | 6.3 | 6.9 | 6.9 | 4.0 | 2.5 | 3.0 | 5.2 | 4.9 | 4.95 |
| 19 | 5.3 | 4.6 | 8.75 | 6.3 | 6.9 | 6.7 | 4.0 | 2.6 | 3.0 | 5.2 | 5.0 | 4.95 |
| 20 | 5.3 | 4.7 | 8.7 | 6.3 | 6.8 | 6.5 | 3.9 | 2.6 | 3.2 | 5.1 | 4.9 | 4.95 |
| 21 | 5.0 | 4.7 | 8.65 | 6.45 | 6.5 | 6.5 | 3.7 | 2.6 | 3.1 | 5.0 | 5.0 | 5.05 |
| 22 | 4.98 | 5.5 | 8.6 | 6.75 | 6.6 | 6.4 | 3.4 | 2.55 | 3.1 | 5.0 | 5.0 | 5.1 |
| 23 | 4.9 | 5.9 | 8.4 | 7.0 | 6.5 | 6.4 | 3.8 | 2.6 | 3.15 | 5.0 | 5.05 | 5.2 |
| 24 | 4.88 | 5.9 | 8.2 | 7.2 | 6.5 | 6.4 | 4.0 | 2.5 | 3.2 | 5.0 | 5.0 | 4.85 |
| 25 | 4.92 | 5.78 | 8.0 | 7.8 | 6.4 | 6.6 | 3.8 | 2.5 | 3.3 | 4.9 | 4.95 | 4.85 |
| 26 | 4.96 | 5.82 | 8.0 | 8.55 | 6.4 | 6.5 | 3.7 | 2.5 | 3.3 | 5.0 | 4.9 | 4.9 |
| 27 | 5.0 | 6.3 | 7.9 | 9.2 | 6.2 | 6.4 | 3.5 | 2.5 | 3.35 | 5.8 | 5.0 | 4.95 |
| 28 | 4.95 | 6.5 | 7.6 | 9.0 | 6.4 | 6.7 | 3.4 | 2.5 | 3.4 | 6.2 | 5.1 | 5.0 |
| 29 | 5.2 | ....... | 7.58 | 8.5 | 6.7 | 6.9 | 3.3 | 2.5 | 3.5 | 6.3 | 5.3 | 5.0 |
| 30 | 5.15 | ....... | 7.25 | 8.2 | 7.3 | 7.1 | 3.35 | 2.55 | 3.6 | 6.4 | 5.3 | 4.95 |
| 31 | 5.2 | ....... | 7.0 | ....... | 7.8 | ....... | 3.30 | 2.4 | ....... | 5.8 | ....... | 4.95 |

*Station rating table for Yakima River at Kiona, Wash., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.40 | 142 | 3.90 | 835 | 5.40 | 2,420 | 7.80 | 6,940 |
| 2.50 | 164 | 4.00 | 910 | 5.50 | 2,560 | 8.00 | 7,400 |
| 2.60 | 188 | 4.10 | 990 | 5.60 | 2,700 | 8.20 | 7,870 |
| 2.70 | 215 | 4.20 | 1,070 | 5.70 | 2,850 | 8.40 | 8,350 |
| 2.80 | 245 | 4.30 | 1,160 | 5.80 | 3,000 | 8.60 | 8,830 |
| 2.90 | 280 | 4.40 | 1,250 | 5.90 | 3,160 | 8.80 | 9,320 |
| 3.00 | 315 | 4.50 | 1,350 | 6.00 | 3,320 | 9.00 | 9,820 |
| 3.10 | 355 | 4.60 | 1,450 | 6.20 | 3,650 | 9.20 | 10,320 |
| 3.20 | 395 | 4.70 | 1,560 | 6.40 | 3,990 | 9.40 | 10,840 |
| 3.30 | 440 | 4.80 | 1,670 | 6.60 | 4,350 | 9.60 | 11,360 |
| 3.40 | 490 | 4.90 | 1,780 | 6.80 | 4,740 | 9.80 | 11,880 |
| 3.50 | 555 | 5.00 | 1,900 | 7.00 | 5,160 | 10.00 | 12,400 |
| 3.60 | 620 | 5.10 | 2,020 | 7.20 | 5,600 | 10.20 | 12,920 |
| 3.70 | 690 | 5.20 | 2,150 | 7.40 | 6,040 | 10.40 | 13,450 |
| 3.80 | 760 | 5.30 | 2,280 | 7.60 | 6,480 | | |

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1902-1905. It is well defined.

*Estimated monthly discharge of Yakima River at Kiona, Wash., for 1905.*

[Drainage area, 5,230 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3,016 | 1,250 | 2,126 | 130,700 | 0.407 | 0.469 |
| February | 4,170 | 1,115 | 1,972 | 109,500 | .377 | .393 |
| March | 10,970 | 4,445 | 8,477 | 521,200 | 1.62 | 1.87 |
| April | 10,320 | 3,320 | 4,998 | 297,400 | .956 | 1.07 |
| May | 6,940 | 3,650 | 4,720 | 290,200 | .902 | 1.04 |
| June | 13,450 | 3,990 | 7,143 | 425,100 | 1.37 | 1.53 |
| July | 4,740 | 440 | 1,757 | 108,000 | .336 | .387 |
| August | 465 | 142 | 240 | 14,760 | .046 | .053 |
| September | 620 | 142 | 304 | 18,090 | .058 | .065 |
| October | 4,740 | 690 | 2,522 | 155,100 | .482 | .556 |
| November | 2,700 | 1,780 | 2,071 | 123,200 | .396 | .442 |
| December | 2,280 | 1,725 | 1,980 | 121,800 | .379 | .437 |
| The year | 13,450 | 142 | 3,192 | 2,315,000 | .611 | 8.31 |

## CANALS IN YAKIMA VALLEY, WASHINGTON.

Nowhere in the State of Washington has irrigation been practiced longer or have matters pertaining to irrigation reached a higher state of development than in Yakima Valley. The rapid fall of the rivers, the great fertility of the soil, and the climatic conditions have all served to bring this about.

The chief sources of water supply for irrigation canals are Yakima and Naches rivers. The Naches, when it joins the Yakima, has already received the water of the Tieton. Besides these rivers, Wenas, Cowiche, Atanum, Toppenish, and Satus creeks, with some small creeks in the vicinity of Ellensburg, irrigate large areas of land lying in the valleys through which they flow. About 100,000 acres of land are at present under irrigation from these sources, and with the available storage reservoirs at the heads of Yakima, Naches, and Tieton rivers, it is probable that 300,000 acres additional could be irrigated, if the water were used economically.

There are at the present time about 50 irrigating canals in operation in Yakima Valley, which obtain their water from the sources above mentioned and irrigate the low land lying near the streams. This land is of volcanic origin and very fertile. Where water is applied large and very profitable crops of fruit, hay, hops, and grain are raised.

A large area of the best quality of land in Yakima Valley remains unirrigated, but the available water supply, especially at low stages of the streams, is practically exhausted, so that the irrigation of additional land is dependent on the feasibility of storing water, to be used during about two and one-half months of the irrigation season.

There are five reservoir sites available in the Yakima region. These are Lake Clealum, Lake Kachess, and Lake Keechelus, at the head of Yakima River, having a combined capacity of about 370,000 acre-feet; Bumping Lake, at the head of Naches River, with a storage capacity of 22,000 acre-feet, and McAlisters Meadows, on Tieton River, with a storage capacity of 35,000 acre-feet, giving a total of about 427,000 acre-feet, which is enough to maintain a flow of 2,300 second-feet for a period of two and one-half months, or during the dry portion of the irrigation season. This amount of water, with a liberal allowance for loss in transmission, could easily be made to irrigate 150,000 acres of land and might be made to irrigate, with economical use, much more than this amount.

The canals at present in operation in Yakima Valley are mostly in the hands of stock companies and with but few exceptions furnish the farmers under them water enough to supply all demands. Most farmers have taken from the ditches as much water as seemed most convenient for their use; this in many instances has been far in excess of the amount actually needed to irrigate their land economically and profitably. The results of this excessive use of water are only too apparent to those who have traveled through the oldest irrigated sections of Yakima Valley. Land that was once valuable is now water-logged and worthless, alkali being everywhere visible.

The following table gives a list of canals on which observations were made during the irrigation season of 1905. The results of measurements of canals and ditches in Yakima Valley made during 1904 are contained in Water-Supply Paper No. 135, United States Geological Survey.

*Canals taking water from Yakima River.*

| Canal. | Location. | | | | Bank of river. | Length in miles. |
|---|---|---|---|---|---|---|
| | Nearest town. | Head works. | | | | |
| | | Section. | Township. | Range. | | |
| *Below Clealum River and above Naches River.* | | | | | | |
| Cascade | Thorp | | 19 N. | 17 E. | Left | 42½ |
| West Kittitas | do | 33 | 19 N. | 17 E. | Right | 14 |
| Town | Ellensburg | 7 | 18 N. | 17 E. | Left | 30 |
| Olsen | do | 18 | 18 N. | 18 E. | do | |
| Fogarty | do | | | | Right | |
| Selah Moxee | North Yakima | 8 | 14 N. | 19 E. | Left | 27 |
| Taylor | do | | | | Right | 4½ |
| *Below Naches River and above Atanum Creek.* | | | | | | |
| Moxee | North Yakima | 7 | 13 N. | 19 E. | Left | 8 |
| Hubbard | do | 7 | 13 N. | 19 E. | do | 7 |
| Fowler | do | 18 | 13 N. | 19 E. | do | 8½ |
| Granger | do | 18 | 13 N. | 19 E. | do | |
| *Below Atanum Creek.* | | | | | | |
| New Reservation No. 2 | Yakima | 17 | 12 N. | 19 E. | Right | (a) |
| Old Reservation No. 1 | do | 28 | 12 N. | 19 E. | do | 12½ |
| Sunnyside | do | 28 | 12 N. | 19 E. | Left | 38 |
| Benton Water Co | Kiona | | | | do | |
| Kiona | do | 10 | 9 N. | 26 E. | do | 9 |
| Kiona Water Supply Co | do | | | | do | |
| Kennewick | Kennewick | 3 | 10 N. | 27 E. | Right | 39½ |
| Grosscup's | Kiona | 3 | 10 N. | 27 E. | Left | 5½ |

[a] Not completed. Proposed length, 65 miles.

*Canals taking water from Naches River.*

| Canal. | Location. | | | | Bank of river. | Length in miles. |
|---|---|---|---|---|---|---|
| | Nearest town. | Head works. | | | | |
| | | Section. | Township. | Range. | | |
| Selah Valley | North Yakima | 35 | 15 N. | 16 E. | Left | 20 |
| *Below Tieton River and above Cowiche Creek.* | | | | | | |
| Wapatox | North Yakima | 36 | 15 N. | 16 E. | Left | 16 |
| Cox | do | 6 | 14 N. | 17 E. | Right | |
| Upper Scott | do | 4 | 14 N. | 17 E. | do | |
| Lower Scott | do | 9 | 14 N. | 17 E. | do | |
| Fortune | do | 9 | 14 N. | 17 E. | do | |
| Laswell | do | 14 | 14 N. | 17 E. | do | |
| Yakima Valley | do | 24 | 14 N. | 17 E. | do | 22 |
| Clark | do | | 14 N. | 17 E. | Left | |
| Lowry | do | | 14 N. | 17 E. | do | |
| Kelly | do | | 14 N. | 17 E. | do | |
| Gleed | do | 24 | 14 N. | 17 E. | do | 6 |
| Morrisey | do | 25 | 14 N. | 17 E. | do | |
| White and Leach | do | | | | do | |
| McCormick | do | | | | do | |
| Shearer-Chapman | do | | | | do | |
| Nelson | do | | | | do | |
| Naches-Cowiche | do | 9 | 13 N. | 18 E. | Right | 7 |
| *Below Cowiche Creek.* | | | | | | |
| Broadgauge | North Yakima | 10 | 13 N. | 18 E. | Right | 3 |
| Power | do | 10 | 13 N. | 18 E. | do | 6 |
| Shanno-Fruitvale | do | 10 | | | do | |
| Shanno | do | 11 | 13 N. | 18 E. | do | 8 |
| Union | do | 11 | 13 N. | 18 E. | do | 8½ |
| Town | do | 12 | 13 N. | 18 E. | do | |

## CASCADE CANAL NEAR THORP, WASH.

This is the first canal taking water from Yakima River. It heads in the river on its left bank in sec. 33, T. 19 N., R. 17 E., about 5½ miles above Thorp.

The gage is at the headgates. Measurements are made in a flume one-half mile below the gage.

*Discharge measurements of Cascade canal near Thorp, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 6 | W. C. Muldrow | 19.2 | 4.19 | 3.0 | 80.0 |
| July 14 | do | 16.0 | 3.81 | 2.65 | 61.0 |
| August 29 | do | 15.6 | 3.77 | 2.65 | 59.0 |
| October 6 | do | 8.0 | 2.61 | 1.6 | 20.9 |

*Daily gage height, in feet, of Cascade canal near Thorp, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.65 | 2.5 | 2.6 | 12 | 2.9 | 2.3 | 2.6 | 2.6 | 22 | 2.7 | 2.6 | 2.6 | 2.55 |
| 2 | ...... | 2.65 | 2.6 | 2.6 | 13 | 2.9 | 2.2 | 2.6 | 2.6 | 23 | 2.7 | 2.6 | 2.7 | 2.6 |
| 3 | ...... | 2.65 | 2.7 | 2.6 | 14 | 2.9 | 2.15 | 2.6 | 2.6 | 24 | 2.7 | 2.6 | 2.7 | 2.6 |
| 4 | ...... | 2.6 | 2.6 | 2.6 | 15 | 2.8 | 2.1 | 2.55 | 2.6 | 25 | 2.7 | 2.65 | 2.7 | 2.65 |
| 5 | ...... | 2.5 | 2.65 | 2.6 | 16 | 2.8 | 2.1 | 2.5 | 2.6 | 26 | 2.7 | 2.65 | 2.6 | 2.65 |
| 6 | ...... | 2.5 | 2.5 | 2.6 | 17 | 2.7 | 2.1 | 2.6 | 2.55 | 27 | 2.7 | 2.6 | 2.6 | 2.7 |
| 7 | 3.0 | 2.45 | 2.5 | 2.6 | 18 | 2.7 | 2.1 | 2.6 | 2.5 | 28 | 2.7 | 2.6 | 2.7 | 2.7 |
| 8 | 3.0 | 2.4 | 2.45 | 2.6 | 19 | 2.7 | 2.6 | 2.7 | 2.5 | 29 | 2.7 | 2.6 | 2.65 | 2.8 |
| 9 | 3.0 | 2.3 | 2.6 | 2.6 | 20 | 2.7 | 2.6 | 2.7 | 2.6 | 30 | 2.7 | 2.6 | 2.6 | 2.9 |
| 10 | 3.0 | 2.3 | 2.55 | 2.6 | 21 | 2.7 | 2.6 | 2.7 | 2.6 | 31 | ...... | 2.5 | 2.6 | ...... |
| 11 | 3.0 | 2.3 | 2.6 | 2.6 | | | | | | | | | | |

### WEST KITTITAS CANAL NEAR THORP, WASH.

This canal heads in Yakima River on its right bank in sec. 33, T. 19 N., R. 17 E., about 3 miles northwest of Thorp.

The gage is attached to a bridge 1½ miles below the head works. Measurements are made from the bridge.

*Discharge measurements of West Kittitas canal near Thorp, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| June 30 | W. C. Muldrow | 12.0 | 1.17 | 1.10 | 14.0 |
| July 10 | do | 27.8 | 1.80 | 2.15 | 50.5 |
| August 29 | do | 33.5 | 2.27 | 2.55 | 73.7 |

*Daily gage height, in feet, of West Kittitas canal near Thorp, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 2.5 | 2.5 | 12 | 2.1 | 2.5 | 2.5 | 22 | 2.4 | 2.5 | 0.3 |
| 2 | 1.1 | 2.5 | 2.5 | 13 | 2.1 | 2.5 | 2.6 | 23 | 2.4 | 2.6 | .3 |
| 3 | 1.4 | 2.5 | 2.5 | 14 | 2.2 | 2.5 | 2.6 | 24 | 2.4 | 2.6 | 2.2 |
| 4 | 1.9 | 2.5 | 2.5 | 15 | 2.2 | 2.5 | 2.6 | 25 | 2.4 | 2.6 | ...... |
| 5 | 1.9 | 2.5 | 2.5 | 16 | 2.4 | 2.5 | 2.5 | 26 | 2.4 | 2.5 | ...... |
| 6 | 1.9 | 2.5 | 2.5 | 17 | 2.3 | 2.5 | 1.8 | 27 | 2.4 | 2.5 | ...... |
| 7 | 2.0 | 2.5 | 2.6 | 18 | 2.3 | 2.5 | .4 | 28 | 2.5 | 2.5 | .7 |
| 8 | 1.9 | 2.5 | 2.6 | 19 | 2.3 | ...... | .4 | 29 | 2.5 | 2.5 | .7 |
| 9 | 1.8 | 2.5 | 2.6 | 20 | 2.3 | 2.1 | .4 | 30 | 2.5 | 2.5 | ...... |
| 10 | 2.0 | 2.5 | 2.6 | 21 | 2.4 | 2.2 | .3 | 31 | 2.5 | 2.5 | ...... |
| 11 | 2.0 | 2.5 | 2.5 | | | | | | | | |

### TOWN CANAL NEAR ELLENSBURG, WASH.

This canal heads in the left bank of Yakima River about 9 miles northwest of Ellensburg, in sec. 7, T. 18 N., R. 18 E.

The gage is about one-fourth mile below the head-gates of the canal, and is attached to a cattle bridge, from which measurements are made.

*Discharge measurements of Town canal near Ellensburg, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 13 | W. C. Muldrow | 62 | 2.13 | 3.58 | 132 |
| August 30 | do | 57 | 2.15 | 3.70 | 122 |
| October 6 | do | 42 | 2.07 | 2.90 | 86 |

*Daily gage height, in feet, of Town canal near Ellensburg, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3.7 | 3.85 | 3.4 | 12 | 3.65 | 3.5 | 3.65 | 2.25 | 22 | 3.9 | 3.85 | 3.5 | |
| 2 | | 3.65 | 3.35 | 3.4 | 13 | 3.6 | 3.6 | 3.65 | 2.25 | 23 | 3.9 | 3.85 | 3.6 | |
| 3 | | 3.7 | 3.85 | 3.35 | 14 | 3.6 | 3.6 | 3.65 | | 24 | 3.9 | 3.85 | 3.6 | |
| 4 | | 3.7 | 3.75 | 3.4 | 15 | 3.65 | 3.65 | 3.6 | | 25 | 3.85 | 3.85 | 3.6 | |
| 5 | | 3.65 | 3.75 | 3.1 | 16 | 3.75 | 3.8 | 3.55 | | 26 | 3.85 | 3.85 | 3.6 | |
| 6 | 3.75 | 3.65 | 3.75 | 2.15 | 17 | 3.75 | 3.85 | 3.5 | | 27 | 3.85 | 3.9 | 3.6 | |
| 7 | 3.75 | 3.6 | 3.85 | 2.15 | 18 | 3.85 | 3.9 | 3.5 | | 28 | 3.8 | 3.9 | 3.75 | |
| 8 | 3.8 | 3.6 | 3.8 | 2.2 | 19 | 3.85 | 3.9 | 3.5 | | 29 | 3.75 | 3.85 | 3.4 | |
| 9 | 3.8 | 3.6 | 3.8 | 2.2 | 20 | 3.9 | 3.9 | 3.5 | | 30 | 3.75 | 3.85 | 3.4 | |
| 10 | 3.75 | 3.6 | 3.7 | 2.2 | 21 | 3.9 | 3.9 | 3.5 | | 31 | 3.7 | 3 85 | | |
| 11 | 3.65 | 3.5 | 3.65 | 2.25 | | | | | | | | | | |

### OLSEN CANAL NEAR ELLENSBURG, WASH.

This canal heads in the left bank of Yakima River just below the Town canal.

The gage is attached to a wagon bridge near Charles Kuli's house. Measurements are made from a foot log a short distance above the gage.

*Discharge measurements of Olsen canal near Ellensburg, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 13 | W. C. Muldrow | 12.0 | 1.17 | 1.95 | 14.0 |
| August 30 | do | 14.7 | 1.56 | 2.20 | 23.0 |
| September 21 | do | 14.1 | 1.43 | 2.15 | 20.1 |
| October 6 | do | 18.6 | .50 | 2.00 | 9.3 |

*Daily gage height, in feet, of Olsen canal near Ellensburg, Wash., for 1905.*

| Day. | Sept. | Oct. | Day. | Sept. | Oct. | Day. | Sept. | Oct. | Day. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.05 | 9 | 1.95 | 2.3 | 17 | 2.3 | | 24 | 2.2 | |
| 2 | | 1.95 | 10 | 1.9 | 2.3 | 18 | 2.3 | | 25 | 2.2 | |
| 3 | | 1.95 | 11 | 1.95 | 2.4 | 19 | 2.25 | | 26 | 2.2 | |
| 4 | 1.9 | 1.95 | 12 | 2.3 | | 20 | 2.2 | | 27 | 2.2 | |
| 5 | 1.9 | 1.95 | 13 | 2.3 | | 21 | 2.2 | | 28 | 2.2 | |
| 6 | 1.9 | 2.0 | 14 | 2.3 | | 22 | 2.2 | | 29 | 2.2 | |
| 7 | 1.95 | 2.0 | 15 | 2.25 | | 23 | 2.2 | | 30 | 2.05 | |
| 8 | 1.95 | 2.3 | 16 | 2.25 | | | | | | | |

### SELAH-MOXEE CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Yakima River just below Yakima Canyon, in sec. 8, T. 14 N., R. 19 E. It is the next important canal below the Olsen canal.

The gage is at a footbridge near Selah siding, 1½ miles below the head-gates. Measurements are made from the footbridge.

*Discharge measurements of Selah-Moxee canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 5 | W. C. Muldrow | 3.10 | 1.74 | 2.3 | 54.0 |
| August 11 | do | 41.6 | 1.64 | 2.77 | 68.0 |
| September 9 | do | 40.5 | 1.50 | 2.70 | 60.7 |
| September 30 | do | | | 2.75 | 61.8 |
| October 12 | do | 20.0 | 1.00 | 1.65 | 20.0 |

*Daily gage height, in feet, of Selah-Moxee canal near North Yakima, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. | Day. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 3.0 | 2.8 | 12 | 2.8 | 2.8 | 2.8 | 22 | 2.8 | 2.9 | 2.4 |
| 2 | | 2.9 | 2.9 | 13 | 2.8 | 2.8 | 2.7 | 23 | 2.8 | 2.9 | 2.3 |
| 3 | | 3.0 | 2.8 | 14 | 2.7 | 2.8 | 2.6 | 24 | 2.8 | 3.0 | 2.2 |
| 4 | | 3.0 | 2.8 | 15 | 2.8 | 2.8 | 2.4 | 25 | 2.8 | 3.0 | 2.2 |
| 5 | 2.3 | 2.9 | 2.8 | 16 | 2.7 | 2.8 | 2.4 | 26 | 2.9 | 3.0 | 2.3 |
| 6 | 2.3 | 2.9 | 2.8 | 17 | 2.7 | 2.8 | 2.4 | 27 | 2.9 | 3.0 | 2.3 |
| 7 | 2.4 | 2.9 | 2.8 | 18 | 2.7 | 2.8 | 2.4 | 28 | 2.9 | 3.0 | 2.3 |
| 8 | 2.5 | 2.8 | 2.8 | 19 | 2.7 | 3.0 | 2.4 | 29 | 3.0 | 3.0 | 2.3 |
| 9 | 2.6 | 2.8 | 2.7 | 20 | 2.7 | 2.9 | 2.4 | 30 | 3.0 | 2.8 | 2.4 |
| 10 | 2.8 | 2.9 | 2.7 | 21 | 2.7 | 3.0 | 2.4 | 31 | 3.0 | 2.8 | |
| 11 | 2.8 | 2.8 | 2.7 | | | | | | | | |

### TAYLOR CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the right bank of Yakima River about 4 miles above the mouth of Naches River.

The gage is about 100 feet above the dividing gates. Measurements are made from a foot plank 50 feet below the gage.

*Discharge measurements of Taylor canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 5 | W. C. Muldrow | 12.0 | 1.25 | | 15.0 |
| August 18 | do | 12.0 | 1.23 | 0.95 | 14.6 |
| September 9 | do | 13.6 | 1.38 | 1.10 | 18.7 |
| October 12 | do | 5.0 | .36 | .30 | 1.8 |

*Daily gage height, in feet, of Taylor canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.05 | 0.55 | 12 | | 1.1 | 0.3 | 22 | 1.0 | 1.1 | |
| 2 | | 1.05 | .55 | 13 | | 1.15 | .25 | 23 | 1.0 | 1.1 | |
| 3 | | 1.05 | .55 | 14 | | 1.15 | .3 | 24 | 1.1 | .65 | |
| 4 | | 1.05 | .5 | 15 | | 1.1 | | 25 | 1.05 | .65 | |
| 5 | | 1.05 | .5 | 16 | | 1.1 | | 26 | 1.05 | .6 | |
| 6 | | 1.0 | .5 | 17 | | 1.1 | | 27 | 1.05 | .6 | |
| 7 | | 1.05 | .5 | 18 | 0.95 | 1.15 | | 28 | 1.05 | .6 | |
| 8 | | 1.1 | .45 | 19 | .95 | 1.15 | | 29 | 1.1 | .55 | |
| 9 | | 1.2 | .3 | 20 | .9 | 1.15 | | 30 | 1.1 | .55 | |
| 10 | | 1.15 | .3 | 21 | 1.0 | 1.1 | | 31 | 1.05 | | |
| 11 | | 1.1 | .3 | | | | | | | | |

## MOXEE CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Yakima River near the line between secs. 7 and 18, T. 13 N., R. 19 E., opposite the town of North Yakima.

The gage is one-half mile below the head-gates on the Moxee hop ranch, about 300 feet above the foot plank from which measurements are made.

*Discharge measurements of Moxee canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 6 | W. C. Muldrow | 7.1 | 1.07 | 0.50 | 7.6 |
| August 21 | do | 17.0 | .99 | 1.05 | 16.8 |
| August 21 | do | 13.4 | 1.00 | 1.05 | 13.4 |
| September 26 | do | 9.3 | .81 | .80 | 7.6 |
| October 13 | do | 5.3 | .45 | .16 | 2.3 |

*Daily gage height, in feet, of Moxee canal near North Yakima, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.25 | 1.1 | 0.75 | 12 | 1.1 | 1.0 | 0.9 | .15 | 22 | 1.0 | 1.15 | 0.65 | |
| 2 | | 1.15 | 1.0 | .75 | 13 | 1.15 | 1.0 | .9 | .15 | 23 | 1.25 | 1.15 | .65 | |
| 3 | | 1.15 | 1.0 | .75 | 14 | 1.15 | .9 | .9 | .15 | 24 | 1.25 | 1.35 | .65 | |
| 4 | | 1.15 | 1.0 | .75 | 15 | 1.15 | 1.0 | 1.0 | .15 | 25 | 1.15 | 1.25 | .65 | |
| 5 | | .85 | 1.15 | .75 | 16 | 1.1 | .9 | .9 | .15 | 26 | 1.15 | 1.15 | .65 | |
| 6 | 0.5 | .65 | 1.15 | .75 | 17 | 1.1 | .9 | .75 | .15 | 27 | 1.4 | 1.15 | .65 | |
| 7 | .5 | .5 | 1.15 | .15 | 18 | 1.1 | .9 | .75 | .15 | 28 | 1.4 | 1.25 | .75 | |
| 8 | .85 | .5 | 1.15 | .15 | 19 | 1.0 | 1.1 | .75 | .15 | 29 | 1.35 | 1.35 | .75 | |
| 9 | .85 | .5 | 1.0 | .15 | 20 | 1.0 | 1.1 | .65 | .15 | 30 | 1.25 | 1.35 | .75 | |
| 10 | 1.15 | 1.0 | 1.0 | .15 | 21 | 1.0 | 1.0 | .65 | .15 | 31 | 1.25 | 1.15 | | |
| 11 | .4 | 1.0 | .9 | .15 | | | | | | | | | | |

### HUBBARD CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Yakima River near the line between secs. 7 and 18, T. 13 N., R. 19 E., opposite the town of North Yakima.

The gage is about one-half mile below the head-gates, at a small flume near the hop house on the Moxee hop ranch. Measurements are made from a wagon bridge 300 feet below the gage.

The Hubbard and Moxee canals have a common head-gate.

*Discharge measurements of Hubbard canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 6 | W. C. Muldrow | 20.0 | 0.72 | 1.33 | 14.3 |
| August 21 | do | 13.1 | 1.61 | 1.50 | 21.1 |
| September 26 | do | 9.8 | 1.02 | 1.20 | 10.2 |
| October 13 | do | 8.6 | .60 | .92 | 5.1 |

*Daily gage height, in feet, of Hubbard canal near North Yakima, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.75 | 1.5 | 1.4 | 12 | 1.75 | 1.15 | 1.4 | 1.0 | 22 | 1.35 | 1.5 | 1.4 | ...... |
| 2 | ...... | 1.75 | 1.5 | 1.4 | 13 | 1.75 | 1.15 | 1.4 | 1.0 | 23 | 1.4 | 1.35 | 1.4 | ...... |
| 3 | ...... | 1.65 | 1.5 | 1.4 | 14 | 1.75 | 1.15 | 1.4 | 1.0 | 24 | 1.5 | 1.4 | 1.25 | ...... |
| 4 | ...... | 1.65 | 1.5 | 1.5 | 15 | 1.75 | 1.35 | 1.4 | 1.0 | 25 | 1.6 | 1.4 | 1.25 | ...... |
| 5 | ...... | 1.65 | 1.5 | 1.5 | 16 | 1.65 | 1.35 | 1.4 | 1.0 | 26 | 1.6 | 1.35 | 1.25 | ...... |
| 6 | 1.35 | 1.65 | 1.4 | 1.5 | 17 | 1.65 | 1.25 | 1.4 | 1.0 | 27 | 1.85 | 1.25 | 1.25 | ...... |
| 7 | 1.35 | 1.65 | 1.5 | 1.0 | 18 | 1.5 | 1.25 | 1.4 | 1.0 | 28 | 1.75 | 1.35 | 1.25 | ...... |
| 8 | 1.5 | 1.5 | 1.5 | 1.0 | 19 | 1.5 | 1.4 | 1.4 | 1.0 | 29 | 1.75 | 1.4 | 1.25 | ...... |
| 9 | 1.5 | 1.5 | 1.4 | 1.0 | 20 | 1.35 | 1.4 | 1.35 | 1.0 | 30 | 1.75 | 1.6 | 1.4 | ...... |
| 10 | 1.9 | 1.4 | 1.4 | 1.0 | 21 | 1.35 | 1.6 | 1.35 | 1.0 | 31 | 1.75 | 1.4 | ...... | ...... |
| 11 | 1.85 | 1.35 | 1.4 | 1.0 | | | | | | | | | | |

### FOWLER CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in Yakima River, in sec. 18, T. 13 N., R. 19 E.

The gage is in a flume one-half mile below the head-gates, on the Moxie hop ranch, opposite the town of North Yakima. Measurements are made at the gage.

*Discharge measurements of Fowler canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 6 | W. C. Muldrow | 9.7 | 2.02 | 0.75 | 19.6 |
| August 21 | do | 11.7 | 2.04 | .92 | 23.9 |
| September 26 | do | 9.0 | 1.48 | .55 | 13.4 |

*Daily gage height, in feet, of Fowler canal near North Yakima, Wash., for 1905.*

| Day | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.9 | 0.85 | 0.6 | 12 | .85 | .85 | .65 | | 22 | .9 | .9 | .5 | |
| 2 | | .9 | .85 | .6 | 13 | .85 | .85 | .65 | | 23 | .85 | .9 | .5 | |
| 3 | | .9 | .85 | .6 | 14 | .9 | .85 | .65 | | 24 | .9 | .9 | .65 | |
| 4 | | .85 | .85 | | 15 | .9 | .85 | .65 | | 25 | .9 | .9 | .6 | |
| 5 | | .85 | .85 | | 16 | .9 | .85 | .5 | | 26 | .9 | .9 | .6 | |
| 6 | 0.75 | .85 | .75 | | 17 | .9 | .85 | .5 | | 27 | .9 | .85 | .6 | |
| 7 | .75 | .85 | .65 | | 18 | .9 | .85 | .5 | | 28 | .9 | .85 | .6 | |
| 8 | .75 | .85 | .65 | | 19 | .9 | .9 | .5 | | 29 | .9 | .85 | .6 | |
| 9 | .65 | .85 | .65 | | 20 | .9 | .9 | .5 | | 30 | .9 | .85 | .6 | |
| 10 | .85 | .85 | .65 | | 21 | .9 | .9 | .5 | | 31 | .9 | .85 | | |
| 11 | .9 | .85 | .65 | | | | | | | | | | | |

## NEW RESERVATION CANAL IN YAKIMA INDIAN RESERVATION, WASH.

This is the first canal taking water from Yakima River below Atanum Creek. It was built by the Government to irrigate lands in the Yakima Indian Reservation. It heads in the right bank in sec. 17, T. 12 N., R. 19 E.

The gage is at the first wagon bridge below the headworks. Measurements are made from the bridge.

*Discharge measurements of New Reservation canal in Yakima Indian Reservation, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 16 | W. C. Muldrow | 60 | 1.80 | 1.50 | 108 |
| August 22 | do | 112 | 1.25 | 2.58 | 140 |
| September 20 | do | | | 1.97 | 62 |
| September 27 | do | 79 | .69 | 1.83 | 55 |
| October 24 | do | 50 | .82 | 1.04 | 41 |

*Daily gage height, in feet, of New Reservation canal in Yakima Indian Reservation, Wash., fo 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 1.6 | 2.25 | 1.6 | 12 | 1.5 | 2.15 | 2.55 | | 22 | 1.65 | 2.1 | 2.6 | |
| 2 | 1.5 | 1.6 | 2.3 | 1.65 | 13 | 1.5 | 2.15 | 2.5 | | 23 | 1.65 | 2.1 | 2,6 | |
| 3 | 1.5 | 1.65 | 2.45 | | 14 | 1.5 | 2.2 | 2.5 | | 24 | 1.65 | 2.15 | 2.6 | |
| 4 | 1.15 | 1.75 | 2.6 | | 15 | 1.5 | 2.2 | 2.5 | | 25 | 1.35 | 2.15 | 2.6 | |
| 5 | 1.0 | 1.75 | 2.7 | | 16 | 1.6 | 2.25 | 2.55 | | 26 | 1.35 | 2.15 | 2.0 | |
| 6 | 1.0 | 1.9 | 2.7 | | 17 | 1.6 | 2.2 | 2.6 | | 27 | 1.35 | 2.2 | 2.0 | |
| 7 | 1.1 | 2.0 | 2.7 | | 18 | 1.65 | 2.15 | 2.65 | | 28 | .85 | 2.25 | 1.75 | |
| 8 | 1.15 | 2.25 | 2.65 | | 19 | 1.65 | 2.15 | 3.0 | | 29 | 1.35 | 2.25 | 1.65 | |
| 9 | 1.35 | 2.05 | 2.65 | | 20 | 1.65 | 2.1 | 2.65 | | 30 | 1.45 | 2.25 | 1.6 | |
| 10 | 1.4 | 2.1 | 2.65 | | 21 | 1.65 | 2.1 | 2.65 | | 31 | | 2.25 | 1.7 | |
| 11 | 1.4 | 2.15 | 2.6 | | | | | | | | | | | |

### OLD RESERVATION CANAL IN YAKIMA INDIAN RESERVATION, WASH.

This canal takes water from Yakima River, heading in its right bank, in sec. 28, T. 12 N., R. 19 E., about 4 miles above Wapato station. It was built by the Government to irrigate lands in the Yakima Indian Reservation.

The gage is at the head-gate. Measurements are made from the railway bridge one-fourth mile below the gage.

*Discharge measurements of Old Reservation canal in Yakima Indian Reservation, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 16 | W. C. Muldrow | 37.4 | 3.85 | 2.67 | 144 |
| August 22 | do | 26.4 | 3.07 | 2.08 | 81.4 |
| October 24 | do | 17.6 | 2.01 | 1.40 | 35.4 |

*Daily gage height, in feet, of Old Reservation canal in Yakima Indian Reservation, Wash., for 1905.*

| Day. | May. | June. | July. | Aug. | Day. | May. | June. | July. | Aug. | Day. | May. | June | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.35 | 3.4 | 3.35 | 3.1 | 12 | 3.35 | 2.6 | 3.35 | 2.65 | 22 | 3.35 | 3.35 | 3.25 | 2.25 |
| 2 | 3.35 | 3.5 | 3.25 | 3.1 | 13 | 3.25 | 2.65 | 3.25 | 2.6 | 23 | 3.25 | 3.35 | 3.25 | 2.25 |
| 3 | 3.35 | 3.35 | 3.35 | 3.1 | 14 | 3.25 | 2.65 | 3.15 | 2.5 | 24 | 3.35 | 3.35 | 3.15 | 2.25 |
| 4 | 3.35 | 2.65 | 3.25 | 3.1 | 15 | 3.25 | 2.6 | 3.15 | 2.35 | 25 | 3.35 | 3.25 | 3.15 | 2.25 |
| 5 | 3.35 | 2.65 | 3.35 | 3.0 | 16 | 3.25 | 2.65 | 3.15 | 2.25 | 26 | 3.35 | 3.35 | 3.1 | 2.15 |
| 6 | 3.4 | 2.65 | 3.35 | 3.0 | 17 | 3.25 | 3.1 | 3.15 | 2.25 | 27 | 3.25 | 3.25 | 3.0 | 2.15 |
| 7 | 3.5 | 2.65 | 3.25 | 3.0 | 18 | 3.35 | 3.15 | 3.15 | 2.41 | 28 | 3.25 | 3.35 | 3.15 | 2.15 |
| 8 | 3.6 | 2.6 | 3.35 | 3.0 | 19 | 3.35 | 3.25 | 3.15 | 2.25 | 29 | 3.35 | 3.35 | 3.15 | 2.15 |
| 9 | 3.6 | 2.6 | 3.5 | 2.9 | 20 | 3.35 | 3.25 | 3.1 | 2.25 | 30 | 3.4 | 3.25 | 3.2 | 2.25 |
| 10 | 3.35 | 2.65 | 3.4 | 2.85 | 21 | 3.35 | 3.25 | 3.0 | 2.25 | 31 | 3.35 | ...... | 3.1 | 2.25 |
| 11 | 3.25 | 2.6 | 3.4 | 2.75 | | | | | | | | | | |

### SUNNYSIDE CANAL NEAR YAKIMA, WASH.

This canal, which is owned and operated by the Washington Irrigation Company, heads in the east bank of Yakima River, 5 miles below the town of Yakima. It is several times larger than any other canal in the Yakima region, the maximum flow being about 670 second-feet.

The gage is in a concrete gage box about 400 feet below the head-gates. Measurements are made from a footbridge about 400 feet below the gage.

*Discharge measurements of Sunnyside canal near Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 15 | W. C. Muldrow | 175 | 3.00 | 4.35 | 526 |
| July 25 | do | 210 | 3.09 | 5.06 | 649 |
| September 28 | do | 162 | 2.90 | 4.00 | 469 |
| October 25 | do | 128 | 2.35 | 3.35 | 301 |
| November 5 | do | 68.8 | 2.01 | 2.00 | 139 |

*Daily gage height, in feet, of Sunnyside canal near Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 4.7 | 5.15 | 4.75 | 3.95 | 17 | 4.2 | 5.1 | 4.6 | 4.05 | 3.4 |
| 2 | ...... | 4.7 | 5.15 | 4.75 | 3.95 | 18 | 4.4 | 5.1 | 4.6 | 3.95 | 3.4 |
| 3 | ...... | 4.7 | 5.15 | 4.65 | 3.95 | 19 | 4.5 | 5.1 | 4.9 | 3.95 | 3.4 |
| 4 | ...... | 4.7 | 5.15 | 4.65 | 3.8 | 20 | 4.5 | 5.1 | 5.1 | 3.95 | 3.4 |
| 5 | ...... | 4.7 | 5.15 | 4.65 | 3.7 | 21 | 4.5 | 0.0 | 5.15 | 3.95 | 3.5 |
| 6 | ...... | 4.8 | 5.15 | 4.55 | 3.7 | 22 | 4.6 | 5.1 | 5.0 | 3.95 | 3.5 |
| 7 | ...... | 4.9 | 5.15 | 4.55 | 3.7 | 23 | 4.6 | 0.0 | 4.65 | 3.95 | 3.3 |
| 8 | ...... | 4.9 | 5.15 | 4.55 | 3.4 | 24 | 4.7 | 5.1 | 4.6 | 3.95 | 3.3 |
| 9 | ...... | 5.0 | 5.15 | 4.55 | 3.4 | 25 | 4.7 | 5.1 | 4.8 | 3.95 | 3.3 |
| 10 | ...... | 5.0 | 5.15 | 4.55 | 3.4 | 26 | 4.7 | 5.1 | 4.8 | 3.95 | 3.3 |
| 11 | ...... | 5.0 | 4.9 | 4.55 | 3.4 | 27 | 4.7 | 5.15 | 4.8 | 3.95 | 3.3 |
| 12 | ...... | 5.0 | 4.9 | 4.55 | 3.4 | 28 | 4.7 | 5.15 | 4.8 | 3.95 | 3.3 |
| 13 | ...... | 5.0 | 4.8 | 4.4 | 3.4 | 29 | 4.7 | 5.15 | 4.8 | 3.95 | 3.3 |
| 14 | ...... | 5.1 | 4.75 | 4.4 | 3.4 | 30 | 4.7 | 5.15 | 4.75 | 3.95 | 3.3 |
| 15 | 4.2 | 5.1 | 4.6 | 4.4 | 3.4 | 31 | ...... | 5.15 | 4.75 | ...... | 3.3 |
| 16 | 4.2 | 5.1 | 4.6 | 4.15 | 3.4 | | | | | | |

## BENTON WATER COMPANY'S CANAL NEAR KIONA, WASH.

This canal takes water from Yakima River near Kiona. It is a new canal, completed late in the irrigation season of 1905.

*Discharge measurements of Benton Water Company's canal near Kiona, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 23 | W. C. Muldrow | 8.0 | 0.86 | 0.30 | 6.9 |
| September 13 | do | 16.1 | 1.23 | .60 | 19.8 |

*Daily gage height, in feet, of Benton Water Company's canal near Kiona, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.1 | 1.0 | 12 | ...... | 0.55 | 0.3 | 22 | ...... | 0.9 | ...... |
| 2 | ...... | .15 | 1.0 | 13 | ...... | .55 | .3 | 23 | 0.3 | .9 | ...... |
| 3 | ...... | .3 | 1.0 | 14 | ...... | .6 | .3 | 24 | .3 | .9 | ...... |
| 4 | ...... | .3 | 1.0 | 15 | ...... | .6 | .3 | 25 | .2 | .9 | ...... |
| 5 | ...... | .4 | .4 | 16 | ...... | .7 | .3 | 26 | .2 | .9 | ...... |
| 6 | ...... | .5 | .4 | 17 | ...... | .7 | .3 | 27 | .2 | .9 | ...... |
| 7 | ...... | .5 | .4 | 18 | ...... | .7 | .3 | 28 | .2 | .9 | ...... |
| 8 | ...... | .5 | .4 | 19 | ...... | .8 | ...... | 29 | .1 | 1.0 | ...... |
| 9 | ...... | .6 | .4 | 20 | ...... | .8 | ...... | 30 | .1 | 1.0 | ...... |
| 10 | ...... | .6 | .3 | 21 | ...... | .8 | ...... | 31 | .1 | ...... | ...... |
| 11 | ...... | .6 | .3 | | | | | | | | |

### KIONA CANAL NEAR KIONA, WASH.

This canal heads in the left bank of Yakima River about 5 miles west of Kiona, in sec. 10, T. 9 N., R. 26 E. The canal is controlled by the Northern Pacific Irrigation Company. On account of the shifting of the channel at the gaging station the estimates of discharge of this canal are only approximate.

The gage is about 400 feet below the head-gates. Measurements are made from a foot plank near the gage.

*Discharge measurements of Kiona canal near Kiona, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 12 | W. C. Muldrow | 20.4 | 1.17 | 3.00 | 23.9 |
| August 24 | do | 19.0 | 1.26 | 3.00 | 23.9 |
| August 24 | do | 6.8 | .50 | 2.00 | 3.4 |

*Daily gage height, in feet, of Kiona canal near Kiona, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | ...... | 3.25 | 3.1 | 3.0 | 17 | 3.15 | 3.25 | 3.45 | 3.0 | ...... |
| 2 | ...... | ...... | 3.3 | 3.1 | 3.0 | 18 | 3.15 | 3.15 | 3.45 | 3.0 | ...... |
| 3 | ...... | ...... | 3.3 | 3.1 | 2.5 | 19 | 3.25 | 3.1 | 3.4 | 3.0 | ...... |
| 4 | ...... | ...... | 3.3 | 3.1 | 2.5 | 20 | 3.25 | 3.0 | 3.35 | 3.0 | ...... |
| 5 | ...... | ...... | 3.3 | 3.1 | 2.5 | 21 | 3.4 | 3.0 | 3.35 | 3.0 | ...... |
| 6 | ...... | ...... | 3.35 | 3.1 | 2.5 | 22 | 3.4 | 3.0 | 3.1 | 3.0 | ...... |
| 7 | ...... | ...... | 3.35 | 3.1 | 2.5 | 23 | 3.4 | 3.0 | 3.1 | 3.0 | ...... |
| 8 | ...... | 2.9 | 3.25 | 3.1 | 2.5 | 24 | 3.6 | 3.0 | 3.0 | 3.0 | ...... |
| 9 | ...... | 2.9 | 3.3 | 3.1 | 2.5 | 25 | ...... | 3.0 | 3.0 | 3.0 | ...... |
| 10 | ...... | 3.15 | 3.4 | 3.1 | 2.5 | 26 | ...... | 2.9 | 3.0 | 3.0 | ...... |
| 11 | ...... | 3.25 | 3.55 | 3.1 | 2.5 | 27 | ...... | 2.9 | 3.1 | 3.0 | ...... |
| 12 | 3.0 | 3.25 | 3.5 | 3.1 | 2.5 | 28 | ...... | 2.85 | 3.1 | 3.0 | ...... |
| 13 | 3.1 | 3.35 | 3.5 | 3.1 | 2.7 | 29 | ...... | 2.9 | 3.1 | 3.0 | ...... |
| 14 | 3.1 | 3.35 | 3.5 | 3.1 | 2.5 | 30 | ...... | 3.0 | 3.1 | 3.0 | ...... |
| 15 | 3.1 | 3.25 | 3.5 | 3.1 | 2.5 | 31 | ...... | 3.15 | 3.1 | ...... | ...... |
| 16 | 3.15 | 3.25 | 3.5 | 3.1 | ...... | | | | | | |

### KIONA WATER SUPPLY COMPANY'S CANAL NEAR KIONA, WASH.

This canal heads in the left bank of Yakima River about 1 mile above Kiona. It is owned by a stock company of 150 shares. It is a power canal used to turn small irrigating wheels. Nearly all the water taken in at the head is returned to the river.

The gage is 200 feet below the footbridge from which measurements are made, near the dwelling of A. A. McAlpin.

*Discharge measurements of Kiona Water Supply Company's canal near Kiona, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 14 | W. C. Muldrow | 7.8 | 0.96 | 1.50 | 7.5 |
| October 18 | do | 9.3 | 1.07 | 1.90 | 10.0 |

*Daily gage height, in feet, of Kiona Water Supply Company's canal near Kiona, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.2 | 1.8 | 12 | ...... | 1.3 | 2.0 | 22 | ...... | 1.8 | ...... |
| 2 | ...... | 1.2 | 1.8 | 13 | ...... | 1.3 | 2.0 | 23 | ...... | 1.8 | ...... |
| 3 | ...... | 1.1 | 1.9 | 14 | ...... | 1.5 | 2.0 | 24 | ...... | 1.8 | ...... |
| 4 | ...... | 1.1 | 2.0 | 15 | ...... | 1.6 | ...... | 25 | ...... | 1.8 | ...... |
| 5 | ...... | 1.1 | 2.0 | 16 | ...... | 1.7 | ...... | 26 | ...... | 1.8 | ...... |
| 6 | ...... | 1.2 | 2.0 | 17 | ...... | 1.7 | ...... | 27 | 0.7 | 1.8 | ...... |
| 7 | ...... | 1.2 | 2.0 | 18 | ...... | 1.7 | ...... | 28 | .9 | 1.8 | ...... |
| 8 | ...... | 1.3 | 2.0 | 19 | ...... | 1.7 | ...... | 29 | 1.0 | 1.8 | ...... |
| 9 | ...... | 1.3 | 2.0 | 20 | ...... | 1.7 | ...... | 30 | 1.0 | 1.8 | ...... |
| 10 | ...... | 1.3 | 2.0 | 21 | ...... | 1.7 | ...... | 31 | 1.1 | ...... | ...... |
| 11 | ...... | 1.3 | 2.0 | | | | | | | | |

### KENNEWICK CANAL NEAR KENNEWICK, WASH.

This canal is owned and operated by the Northern Pacific Irrigation Company. Next to the Sunnyside it is the largest irrigation canal in Yakima Valley. It takes water from Yakima River on its right bank just above Horn Rapids, about 11 miles north of Kiona, in sec. 3, T. 10 N., R. 27 E.

The gage is at a bridge 1¼ miles below the head-gates. Measurements are made from the bridge.

*Discharge measurements of Kennewick canal near Kennewick, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 10 | W. C. Muldrow | 68 | 1.5 | 2.83 | 102 |
| August 23 | do | 76 | 2.14 | 3.42 | 162 |
| September 14 | do | 83 | 2.10 | 3.47 | 174 |

*Daily gage height, in feet, of Kennewick canal near Kennewick, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 3.35 | 3.5 | 3.25 | 3.25 | 17 | 3.35 | 3.4 | 2.9 | 3.5 | 3.1 |
| 2 | ...... | 3.35 | 3.5 | 3.15 | 3.25 | 18 | 3.4 | 3.4 | 3.0 | 3.5 | 3.1 |
| 3 | ...... | 3.35 | ...... | 3.25 | 3.25 | 19 | 1.75 | 3.4 | 3.15 | 3.4 | 3.1 |
| 4 | ...... | 3.4 | 2.5 | 3.35 | 3.15 | 20 | 1.75 | 3.4 | 3.15 | 3.35 | 3.1 |
| 5 | ...... | 3.4 | ...... | 3.35 | 3.25 | 21 | 2.9 | 3.5 | 3.25 | 3.35 | 1.0 |
| 6 | ...... | 3.4 | 2.5 | 3.4 | 3.25 | 22 | 3.35 | 3.5 | 3.35 | 3.35 | 2.15 |
| 7 | ...... | 3.4 | 2.75 | 3.4 | 3.15 | 23 | 3.4 | 3.5 | 3.4 | 3.35 | 2.85 |
| 8 | ...... | 3.8 | 2.0 | 3.35 | 3.0 | 24 | 3.4 | 3.5 | 3.35 | 3.35 | 2.85 |
| 9 | ...... | 3.4 | 2.0 | 3.25 | 3.0 | 25 | 3.4 | 3.5 | 3.25 | 3.35 | 2.85 |
| 10 | 2.85 | 3.4 | 2.0 | 3.5 | 3.0 | 26 | 3.35 | 3.5 | 3.25 | 3.35 | 2.85 |
| 11 | 2.85 | 3.4 | 2.4 | 3.35 | 2.95 | 27 | 3.35 | 3.5 | 3.25 | 3.35 | 2.85 |
| 12 | 2.85 | 3.4 | 2.6 | 3.4 | 2.75 | 28 | 3.35 | 3.5 | 3.15 | 3.25 | 2.85 |
| 13 | 2.85 | 3.4 | 3.15 | 3.4 | 3.1 | 29 | 3.35 | 3.5 | 3.35 | 3.35 | 2.85 |
| 14 | 3.25 | 3.4 | 3.1 | 3.4 | 3.1 | 30 | 3.35 | 3.5 | 3.35 | 3.25 | 1.15 |
| 15 | 3.25 | 3.4 | 3.0 | 3.4 | 3.1 | 31 | ...... | 3.5 | 3.25 | ...... | 1.15 |
| 16 | 3.35 | 3.4 | 2.9 | 3.5 | 3.1 | | | | | | |

### GROSSCUP CANAL NEAR KIONA, WASH.

This canal heads in Yakima River on its left bank at Horn Rapids, directly opposite the intake of the Kennewick canal. The same diversion weir is used for both canals.

The gage is 1 mile below the head-gates, at a highway bridge, from which measurements are made.

*Discharge measurements of Grosscup canal near Kiona, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 13 | W. C. Muldrow | 2.9 | 1.55 | 0.50 | 4.5 |
| August 23 | do | 3.3 | 1.66 | .60 | 5.5 |
| September 13 | do | 3.4 | 1.94 | .70 | 6.6 |

*Daily gage height, in feet, of Grosscup canal near Kiona, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.6 | 1.0 | 0.8 | 12 | 0.6 | .8 | .8 | .8 | 22 | .7 | 1.0 | .8 | .8 |
| 2 | | .6 | 1.0 | .8 | 13 | .6 | .8 | .8 | .8 | 23 | .7 | 1.0 | .8 | .8 |
| 3 | | .6 | 1.0 | .8 | 14 | .7 | .9 | .7 | .8 | 24 | .7 | 1.0 | .8 | .8 |
| 4 | | .6 | 1.0 | .8 | 15 | .7 | 1.0 | .8 | .8 | 25 | .7 | 1.0 | .8 | .8 |
| 5 | | .6 | 1.0 | .8 | 16 | .7 | 1.0 | .8 | .8 | 26 | .7 | 1.0 | .8 | .8 |
| 6 | | .6 | 0.0 | .8 | 17 | .6 | 1.0 | .8 | .8 | 27 | .7 | 1.0 | .8 | .8 |
| 7 | | .6 | 0.0 | .8 | 18 | .6 | 1.0 | .8 | .8 | 28 | .7 | 1.0 | .8 | .8 |
| 8 | | .6 | .8 | .8 | 19 | .7 | 1.0 | .8 | .8 | 29 | .7 | 1.0 | .8 | .8 |
| 9 | | .6 | .8 | .8 | 20 | .7 | 1.0 | .8 | .8 | 30 | .7 | 1.0 | .8 | .8 |
| 10 | | .6 | .8 | .8 | 21 | .7 | 1.0 | .8 | .8 | 31 | | 1.0 | .8 | |
| 11 | | .7 | .8 | .8 | | | | | | | | | | |

### SELAH VALLEY CANAL NEAR NORTH YAKIMA, WASH.

The only important canal taking water from Naches River above the mouth of Tieton River is the Selah Valley canal. There are a few canals above the Selah Valley, but they are small private ditches and their combined flow would probably not exceed 15 second-feet.

The Selah Valley canal heads in Naches River on its left bank about 1 mile above the mouth of the Tieton, in sec. 35, T. 15 N., R. 16 E. With the exception of the Power canal it is the largest canal taking water from the Naches.

The gage is in a flume 1 mile below the head-gates. Measurements are made at the gage.

*Discharge measurements of Selah Valley canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 21 | W. J. Lightfoot | 23.8 | 2.80 | 2.50 | 66.5 |
| July 18 | do | 26.0 | 3.23 | 2.80 | 84.1 |
| August 3 | do | 24.6 | 3.37 | 2.65 | 83.0 |
| September 5 | do | 12.3 | 1.71 | 1.20 | 21.0 |
| October 10 | do | 13.5 | 1.89 | 1.40 | 25.6 |

*Daily gage height, in feet, of Selah Valley canal near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 2.4 | 2.75 | 2.7 | 2.1 | 17 | ....... | 2.7 | 0.0 | 2.35 | 1.5 |
| 2 | ....... | 2.4 | 2.75 | ....... | 2.0 | 18 | 2.6 | 2.75 | 0.0 | 2.35 | 1.5 |
| 3 | ....... | 2.4 | 2.75 | ....... | 1.95 | 19 | 2.6 | 2.75 | 0.0 | 2.35 | 1.45 |
| 4 | ....... | 2.4 | 2.65 | ....... | 1.9 | 20 | 2.6 | 2.75 | 1.6 | 2.35 | 1.45 |
| 5 | ....... | 2.4 | 2.65 | 1.15 | 1.9 | 21 | 2.6 | 2.75 | 1.5 | 2.3 | 1.45 |
| 6 | ....... | 2.4 | 2.65 | 1.15 | 1.8 | 22 | 2.55 | 2.75 | 2.6 | 2.35 | 1.4 |
| 7 | ....... | 2.5 | 2.65 | 2.0 | 1.6 | 23 | 2.55 | 2.4 | 2.75 | 2.25 | 1.4 |
| 8 | ....... | 2.6 | 2.6 | 2.6 | 1.4 | 24 | 2.55 | 2.4 | 2.4 | 2.25 | 1.4 |
| 9 | ....... | 2.6 | 2.6 | 2.5 | 1.4 | 25 | 2.55 | 2.5 | 2.75 | 2.25 | 1.4 |
| 10 | ....... | 2.6 | 2.6 | 2.55 | 1.35 | 26 | 2.55 | 2.65 | 2.75 | 2.15 | 1.4 |
| 11 | ....... | 2.6 | 2.6 | 2.45 | 1.35 | 27 | 2.15 | 2.75 | 2.75 | 2.05 | 1.4 |
| 12 | ....... | 2.6 | 2.6 | 2.45 | 1.35 | 28 | 2.4 | 2.75 | 2.75 | 2.1 | 1.4 |
| 13 | ....... | 2.6 | 2.7 | 2.5 | 1.35 | 29 | 2.4 | 2.75 | 2.75 | 2.1 | 1.4 |
| 14 | ....... | 2.6 | 2.7 | 2.45 | 1.35 | 30 | 2.4 | 2.75 | 2.75 | 2.1 | 1.5 |
| 15 | ....... | 2.65 | 2.75 | 2.45 | 1.4 | 31 | ....... | 2.75 | 2.75 | ....... | 1.5 |
| 16 | ....... | 2.7 | 2.75 | 2.4 | 1.4 | | | | | | |

## WAPATOX CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Naches River opposite the mouth of Tieton River, in sec. 36, T. 15 N., R. 16 E. It is maintained by a stock company of 100 equal shares.

The gage is 200 feet below the head-gates. Measurements are made from a foot plank 100 feet below the gage.

*Discharge measurements of Wapatox canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 19 | W. C. Muldrow | 18.3 | 1.64 | 1.83 | 30.0 |
| July 18 | do | 28.0 | 1.93 | 2.67 | 54.0 |
| October 10 | do | 8.5 | .82 | .66 | 7.0 |

*Daily gage height, in feet, of Wapatox canal near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 2.0 | 2.5 | 2.75 | 0.65 | 17 | ....... | 2.6 | 0.0 | 2.5 | ....... |
| 2 | ....... | 2.0 | 2.4 | ....... | .65 | 18 | ....... | 2.6 | 0.0 | 2.4 | ....... |
| 3 | ....... | 2.25 | 2.4 | ....... | .65 | 19 | 2.35 | 2.75 | 0.0 | 2.5 | ....... |
| 4 | ....... | 2.25 | 2.3 | ....... | 1.15 | 20 | 2.35 | 2.9 | 2.9 | 2.35 | ....... |
| 5 | ....... | 2.1 | 2.25 | 2.65 | 1.0 | 21 | 2.35 | 2.9 | 2.85 | 2.65 | ....... |
| 6 | ....... | 2.35 | 2.15 | 2.65 | .65 | 22 | 2.35 | 2.85 | 2.9 | 2.4 | ....... |
| 7 | ....... | 2.35 | 2.15 | 2.35 | .65 | 23 | 2.25 | 2.85 | 2.85 | 2.4 | ....... |
| 8 | ....... | 2.65 | 2.25 | 2.6 | .65 | 24 | 2.25 | 2.4 | 2.9 | 2.4 | ....... |
| 9 | ....... | 2.75 | 2.25 | 2.6 | .65 | 25 | 2.25 | 2.25 | 2.85 | 2.35 | ....... |
| 10 | ....... | 2.95 | 2.5 | 2.65 | .65 | 26 | 2.25 | 2.4 | 2.85 | 2.35 | ....... |
| 11 | ....... | 2.65 | 2.5 | 2.6 | .65 | 27 | 2.0 | 2.4 | 2.8 | 2.1 | ....... |
| 12 | ....... | 2.5 | 2.85 | 2.6 | .65 | 28 | 2.0 | 2.4 | 3.1 | 2.0 | ....... |
| 13 | ....... | 2.6 | 2.75 | 2.65 | .65 | 29 | 2.0 | 2.4 | 2.75 | 1.9 | ....... |
| 14 | ....... | 2.65 | 2.65 | 2.6 | .65 | 30 | 1.9 | 2.4 | 2.85 | 1.9 | ....... |
| 15 | ....... | 2.6 | 2.25 | 2.5 | ....... | 31 | ....... | 2.6 | 2.65 | ....... | ....... |
| 16 | ....... | 2.65 | 2.75 | 2.4 | ....... | | | | | | |

### FORTUNE CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the right bank of Naches River on John W. Foster's ranch, 16 miles from North Yakima. Its intake is near that of the Lower Scott canal.

The gage is at a wagon bridge on the road leading to the ford. Measurements are made from the bridge.

*Discharge measurements of Fortune canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 24 | W. C. Muldrow | 12.5 | 0.98 | .......... | 12.3 |
| August 16 | .....do | 7.7 | .60 | 1.60 | 4.7 |
| September 4 | .....do | 14.1 | 1.18 | 2.25 | 16.0 |
| October 9 | .....do | 8.2 | .48 | 1.50 | 4.0 |

*Daily gage height, in feet, of Fortune canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.9 | 2.2 | 12 | ...... | 2.1 | .8 | 22 | 1.7 | 2.2 | ...... |
| 2 | ...... | 1.9 | 1.3 | 13 | ...... | 2.2 | .8 | 23 | 1.5 | 2.2 | ...... |
| 3 | ...... | 2.2 | 1.3 | 14 | ...... | 2.2 | .8 | 24 | 1.4 | 2.2 | ...... |
| 4 | ...... | 2.2 | 1.6 | 15 | ...... | 2.1 | .8 | 25 | 1.0 | 2.1 | ...... |
| 5 | ...... | 2.2 | 1.5 | 16 | 1.6 | 2.2 | 1.1 | 26 | 1.0 | 2.1 | ...... |
| 6 | ...... | 2.1 | 1.6 | 17 | 2.1 | 2.1 | 1.2 | 27 | 1.9 | 2.3 | ...... |
| 7 | ...... | 2.1 | 1.6 | 18 | 2.0 | 2.0 | 1.0 | 28 | 2.2 | 2.1 | ...... |
| 8 | ...... | 2.1 | 1.6 | 19 | 1.7 | 2.0 | 1.0 | 29 | 2.1 | 2.1 | ...... |
| 9 | ...... | 2.1 | 1.5 | 20 | 1.8 | 2.2 | 1.0 | 30 | 2.0 | 2.1 | ...... |
| 10 | ...... | 2.1 | 1.5 | 21 | 1.6 | 2.2 | 1.0 | 31 | 1.9 | ...... | ...... |
| 11 | ...... | 2.1 | 1.5 | | | | | | | | |

### LOWER SCOTT CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the right bank of Naches River on John W Foster's ranch, 16 miles from North Yakima.

The gage is just below the crossing of the road leading to the ford. Measurements are taken from a footbridge near the gage.

*Discharge measurements of Lower Scott canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 24 | W. C. Muldrow | 9.9 | 1.40 | .......... | 14.3 |
| August 16 | .....do | 3.5 | .94 | 0.70 | 3.3 |
| September 4 | .....do | 11.5 | 1.75 | 1.35 | 20.2 |
| October 9 | .....do | 7.3 | 1.51 | 1.05 | 11.0 |

*Daily gage height, in feet, of Lower Scott canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.8 | 1.1 | 12 | ...... | 1.1 | 1.0 | 22 | .6 | 1.3 | ...... |
| 2 | ...... | .8 | 1.1 | 13 | ...... | 1.2 | 1.0 | 23 | .6 | 1.3 | ...... |
| 3 | ...... | 1.6 | 1.1 | 14 | ...... | 1.2 | 1.0 | 24 | .5 | 1.3 | ...... |
| 4 | ...... | 1.3 | 1.1 | 15 | ...... | 1.1 | 1.0 | 25 | .4 | 1.0 | ...... |
| 5 | ...... | 1.1 | 1.1 | 16 | 0.7 | 1.2 | 1.2 | 26 | .4 | .9 | ...... |
| 6 | ...... | 1.1 | 1.1 | 17 | 1.0 | 1.0 | 1.2 | 27 | .8 | 1.0 | ...... |
| 7 | ...... | 1.1 | 1.1 | 18 | 1.0 | 1.0 | 1.1 | 28 | 1.1 | .9 | ...... |
| 8 | ...... | 1.1 | 1.1 | 19 | .8 | 1.0 | 1.1 | 29 | .9 | .9 | ...... |
| 9 | ...... | 1.1 | 1.1 | 20 | .9 | 1.2 | 1.1 | 30 | .9 | .9 | ...... |
| 10 | ...... | 1.1 | 1.1 | 21 | .7 | 1.2 | 1.1 | 31 | .8 | ...... | ...... |
| 11 | ...... | 1.1 | 1.0 | | | | | | | | |

## CLARK CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Naches River, on D. R. Putnam's ranch, about 16 miles from North Yakima.

The gage is one-half mile below the head-gate. Measurements are made from a foot plank near the gage.

*Discharge measurements of Clark canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 21 | W. C. Muldrow | 6.2 | 1.42 | .......... | 8.8 |
| September 4 | do | 10.0 | 1.63 | 1.35 | 16.3 |
| October 11 | do | 7.2 | .70 | .75 | 5.0 |

*Daily gage height, in feet, of Clark canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.4 | ...... | 12 | ...... | 1.3 | 1.0 | 22 | 1.4 | 1.4 | .8 |
| 2 | ...... | 1.7 | 1.3 | 13 | ...... | 1.5 | 1.0 | 23 | 1.4 | 1.4 | ...... |
| 3 | ...... | 1.5 | 1.5 | 14 | ...... | 1.5 | 1.0 | 24 | 1.4 | ...... | ...... |
| 4 | ...... | 1.5 | 1.7 | 15 | ...... | 1.4 | ...... | 25 | 1.4 | 1.5 | ...... |
| 5 | ...... | 1.05 | 1.7 | 16 | ...... | 1.4 | 1.0 | 26 | 1.4 | 1.5 | ...... |
| 6 | ...... | 1.4 | 1.6 | 17 | 1.6 | ...... | .9 | 27 | ...... | 1.5 | ...... |
| 7 | ...... | 1.3 | 1.6 | 18 | 1.5 | 1.3 | .9 | 28 | 1.6 | 1.4 | ...... |
| 8 | ...... | 1.3 | ...... | 19 | 1.5 | 1.3 | .9 | 29 | 1.5 | 1.3 | ...... |
| 9 | ...... | 1.4 | 1.1 | 20 | ...... | 1.3 | .8 | 30 | 1.5 | 1.2 | ...... |
| 10 | ...... | ...... | 1.1 | 21 | 1.4 | 1.4 | .8 | 31 | 1.4 | ...... | ...... |
| 11 | ...... | 1.3 | 1.0 | | | | | | | | |

## LOWERY CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Naches River, about 16 miles from North Yakima.

The gage is at a bridge about 1,200 feet from Harry Painter's store. Measurements are made in a flume about 800 feet above the gage.

*Discharge measurements of Lowery canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 21 | W. C. Muldrow | 12.8 | 1.41 | 2.20 | 18.0 |
| August 16 | ....do | 12.2 | 1.01 | 2.15 | 12.3 |
| September 4 | ....do | 13.3 | 1.74 | 2.85 | 23.1 |
| October 11 | ....do | 9.8 | 1.76 | 2.35 | 17.2 |

*Daily gage height, in feet, of Lowery canal near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Nov. | Day. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.2 | 2.3 | 2.4 | 2.3 | 2.3 | 17 | ...... | 2.3 | 2.4 | 2.3 | 2.3 | 2.4 |
| 2 | ...... | 2.1 | 2.3 | 2.4 | 2.3 | 2.3 | 18 | ...... | 2.3 | 2.3 | 2.3 | 2.3 | 2.4 |
| 3 | ...... | 2.1 | 2.3 | 2.4 | 2.3 | 2.3 | 19 | ...... | 2.3 | 2.3 | 2.3 | 2.3 | 2.4 |
| 4 | ...... | 2.2 | 2.2 | 2.3 | 2.3 | 2.3 | 20 | ...... | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| 5 | ...... | 2.1 | 2.2 | 2.3 | 2.3 | 2.3 | 21 | 2.2 | 2.3 | 2.2 | 2.3 | 2.3 | 2.3 |
| 6 | ...... | 2.1 | 2.2 | 2.3 | 2.3 | 2.4 | 22 | 2.2 | 2.3 | 2.2 | 2.4 | 2.3 | 2.3 |
| 7 | ...... | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 23 | 2.1 | 2.0 | 2.1 | 2.4 | 2.3 | 2.3 |
| 8 | ...... | 2.2 | 2.1 | 2.3 | 2.3 | 2.3 | 24 | 2.2 | 2.0 | 2.1 | 2.3 | 2.3 | 2.3 |
| 9 | ...... | 2.1 | 2.1 | 2.2 | 2.3 | 2.4 | 25 | 2.3 | 2.3 | 2.1 | 2.3 | 2.3 | 2.3 |
| 10 | ...... | 2.2 | 2.1 | 2.2 | 2.3 | 2.4 | 26 | 2.4 | 2.4 | 2.1 | 2.3 | 2.3 | 2.3 |
| 11 | ...... | 2.2 | 2.1 | 2.3 | 2.3 | 2.4 | 27 | 2.2 | 2.3 | 2.1 | 2.3 | 2.3 | 2.3 |
| 12 | ...... | 2.2 | 2.1 | 2.3 | 2.3 | 2.4 | 28 | 2.2 | 2.3 | 2.1 | 2.3 | 2.3 | 2.3 |
| 13 | ...... | 2.1 | 2.1 | 2.3 | 2.3 | 2.4 | 29 | 2.2 | 2.3 | 2.5 | 2.3 | 2.3 | 2.2 |
| 14 | ...... | 2.0 | 2.1 | 2.3 | 2.3 | 2.4 | 30 | 2.2 | 2.2 | 2.5 | 2.3 | 2.3 | 2.2 |
| 15 | ...... | 2.2 | 2.1 | 2.3 | 2.3 | 2.4 | 31 | ...... | 2.2 | 2.4 | ...... | 2.3 | ...... |
| 16 | ...... | 2.2 | 2.3 | 2.3 | 2.3 | 2.4 | | | | | | | |

### GLEED CANAL NEAR NORTH YAKIMA, WASH.

This is the next large canal below the Wapatox. Its intake is on the left bank of Naches River, about 12 miles from North Yakima, in sec. 24, T. 14 N., R. 17 E.

The gage is about three-eighths mile below the head-gates, on Edward Kershaw's ranch, and 600 feet above the forks of the canal. Measurements are made from a foot plank near the gage.

*Discharge measurements of Gleed canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| June 22 | W. C. Muldrow | 43.5 | 1.92 | 2.20 | 83.9 |
| July 10 | ....do | 45.0 | 1.62 | 2.40 | 73.0 |
| July 19 | ....do | 43.0 | 1.72 | 2.08 | 74.0 |
| August 5 | ....do | 48.0 | 1.65 | 2.37 | 79.0 |
| September 6 | ....do | 37.0 | 1.40 | 1.65 | 51.6 |
| October 31 | ....do | 2.75 | 2.76 | .25 | 7.6 |

*Daily gage height, in feet, of Gleed canal near North Yakima, Wash., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.4 | 1.6 | 1.9 | 1.85 | 17 | | 2.1 | 2.1 | 2.0 | 1.25 |
| 2 | | 2.25 | 2.0 | 2.0 | 1.85 | 18 | | 2.1 | 2.1 | 2.0 | 1.25 |
| 3 | | 2.35 | 2.0 | 2.0 | 1.85 | 19 | | 2.1 | 2.1 | 2.0 | 1.25 |
| 4 | | 2.35 | 2.0 | 2.0 | 1.85 | 20 | | 2.1 | 2.1 | 2.0 | 1.25 |
| 5 | | 1.50 | 2.1 | 2.0 | 1.85 | 21 | | 1.5 | 2.35 | 1.9 | |
| 6 | | 1.50 | 2.15 | 2.0 | 1.65 | 22 | 2.0 | 1.5 | 2.35 | 1.85 | |
| 7 | | | 2.15 | 2.0 | 1.65 | 23 | 2.0 | 1.5 | 2.4 | 1.85 | |
| 8 | | | 2.15 | 2.0 | 1.65 | 24 | 2.0 | 1.5 | 2.25 | 1.9 | |
| 9 | | | 2.15 | 2.0 | 1.65 | 25 | 2.0 | 1.5 | 2.25 | 1.9 | |
| 10 | | | 2.25 | 2.0 | 1.65 | 26 | 2.0 | 1.5 | 2.1 | 1.85 | |
| 11 | | | 2.25 | 2.0 | 1.65 | 27 | 2.0 | 1.5 | 2.0 | 1.85 | |
| 12 | | 1.75 | 1.6 | 2.0 | 1.65 | 28 | 2.1 | 1.5 | 2.0 | 1.85 | |
| 13 | | 1.75 | 1.60 | 2.0 | 1.85 | 29 | 2.15 | 1.5 | 2.0 | 1.85 | |
| 14 | | 2.0 | 2.0 | 2.0 | 1.85 | 30 | 2.15 | 1.6 | 2.0 | 1.85 | |
| 15 | | 2.0 | 2.1 | 2.1 | 1.25 | 31 | 2.4 | | 2.1 | 1.85 | |
| 16 | | 2.0 | 2.1 | 2.1 | 1.25 | | | | | | |

*Discharge measurements of Gleed canal wasteway near North Yakima, Wash., in 1905.*[a]

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| July 10 | W. J. Lightfoot | 21 | 29 | 1.24 | | 36 |
| July 19 | do | 16 | 16 | 2.44 | 1.40 | 39 |

[a] Includes waste from all canals on north side of Naches River.

*Daily gage height, in feet, of Gleed canal wasteway near North Yakima, Wash., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. | Day. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.4 | 1.1 | 1.0 | 12 | | 1.2 | 1.1 | 1.3 | 22 | 2.4 | 1.4 | 1.0 | |
| 2 | | 1.4 | 1.1 | 1.2 | 13 | | 1.3 | 1.1 | 1.4 | 23 | 1.8 | 1.4 | 1.1 | |
| 3 | | 1.2 | 1.2 | 1.1 | 14 | | 1.3 | 1.1 | 1.3 | 24 | 1.5 | 1.4 | 1.1 | |
| 4 | | 1.0 | 1.2 | 1.2 | 15 | | 1.2 | 1.1 | 1.0 | 25 | 1.3 | 1.4 | 1.1 | |
| 5 | | 1.3 | 1.1 | 1.4 | 16 | | 1.2 | 1.1 | 1.0 | 26 | 1.3 | 1.4 | 1.1 | |
| 6 | | 1.4 | 1.2 | 1.5 | 17 | | 1.4 | 1.1 | 1.0 | 27 | 1.5 | 1.4 | 1.1 | |
| 7 | | 1.4 | 1.1 | 1.5 | 18 | | 1.4 | 1.1 | 1.0 | 28 | 1.4 | 1.4 | 1.0 | |
| 8 | | 1.3 | 1.1 | 1.2 | 19 | 1.4 | 1.4 | 1.0 | .8 | 29 | 1.4 | 1.5 | 1.0 | |
| 9 | | 1.2 | 1.1 | 1.3 | 20 | 1.3 | 1.3 | 1.0 | .7 | 30 | 1.3 | 1.5 | 1.1 | |
| 10 | | 1.3 | 1.2 | 1.3 | 21 | 1.3 | 1.4 | 1.0 | .7 | 31 | 1.2 | 1.1 | | |
| 11 | | 1.3 | 1.2 | 1.4 | | | | | | | | | | |

## YAKIMA VALLEY CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the right bank of Naches River, 11 miles from North Yakima, in sec. 24, T. 14 N., R. 17 E.

The gage is in a flume 200 feet below the head-gates. Measurements are made from a footbridge 60 feet above the gage.

*Discharge measurements of Yakima Valley canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 24 | W. C. Muldrow | 24.8 | 2.05 | 2.25 | 58.4 |
| August 9 | do | 24.4 | 2.99 | 2.35 | 73.0 |
| September 11 | do | | | 2.05 | 54.6 |
| October 9 | do | 15.3 | 2.0 | 1.35 | 30.7 |

*Daily gage height, in feet, of Yakima Valley canal near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.35 | 2.3 | 2.25 | 1.7 | 17 | | 2.65 | 2.2 | 1.95 | |
| 2 | | 2.35 | 2.3 | 2.25 | 1.65 | 18 | | 2.65 | 2.2 | 1.9 | |
| 3 | | 2.35 | 2.3 | 2.15 | 1.65 | 19 | | 2.9 | 2.2 | 1.85 | |
| 4 | | 2.35 | | 2.15 | 1.65 | 20 | | 2.75 | 2.2 | 1.85 | |
| 5 | | 2.35 | 1.95 | 2.15 | 1.65 | 21 | | 2.3 | 2.2 | 1.8 | |
| 6 | | 2.4 | 1.95 | 2.15 | 1.45 | 22 | | 2.25 | 2.2 | 1.85 | |
| 7 | | 2.45 | 1.95 | 2.15 | 1.45 | 23 | | 2.25 | 2.2 | 1.75 | |
| 8 | | 2.5 | 2.15 | 2.1 | 1.45 | 24 | 2.3 | 2.25 | 2.2 | 1.75 | |
| 9 | | 2.55 | 2.2 | 2.1 | 1.45 | 25 | 2.3 | 2.25 | 2.1 | 1.75 | |
| 10 | | 2.65 | 2.2 | 2.1 | 1.45 | 26 | 2.35 | 2.5 | 2.0 | 1.75 | |
| 11 | | 2.65 | 2.2 | 2.05 | 1.45 | 27 | 2.3 | 2.3 | 2.2 | 1.75 | |
| 12 | | 2.65 | 2.2 | 2.05 | 1.45 | 28 | 2.3 | 2.3 | 2.25 | 1.7 | |
| 13 | | 2.65 | 2.2 | 2.05 | 1.45 | 29 | 2.3 | 2.3 | 2.25 | 1.7 | |
| 14 | | 2.65 | 2.15 | 2.05 | 1.45 | 30 | 2.35 | 2.3 | 2.25 | 1.7 | |
| 15 | | 2.6 | 2.15 | 2.05 | | 31 | | 2.3 | 2.25 | | |
| 16 | | 2.65 | 2.1 | 2.0 | | | | | | | |

## WHITE & LEACH CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Naches River about 10 miles from North Yakima.

The gage is at a wagon bridge on White's ranch. Measurements are made from a footbridge 200 feet above the gage.

*Discharge measurements of White & Leach canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 22 | W. C. Muldrow | 4.7 | 2.32 | | 10.9 |
| August 18 | do | 7.9 | 1.28 | 1.40 | 10.1 |
| September 12 | do | 4.86 | 1.22 | 1.05 | 6.0 |

*Daily gage height, in feet, of White & Leach canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.8 | 1.1 | 12 | ........ | 0.9 | 0.2 | 22 | 1.3 | 1.2 | ...... |
| 2 | ...... | 1.4 | 1.3 | 13 | ........ | 1.3 | .2 | 23 | 1.2 | 1.1 | ...... |
| 3 | ...... | 1.5 | 1.3 | 14 | ........ | 1.3 | .1 | 24 | 1.2 | 1.2 | ...... |
| 4 | ...... | 1.3 | 1.3 | 15 | ........ | 1.0 | ...... | 25 | 1.2 | 1.2 | ...... |
| 5 | ...... | 1.4 | 1.3 | 16 | ........ | .9 | ...... | 26 | 1.2 | 1.3 | ...... |
| 6 | ...... | 1.2 | .8 | 17 | ........ | .9 | ...... | 27 | 1.0 | 1.3 | ...... |
| 7 | ...... | 1.2 | .5 | 18 | 1.4 | .9 | ...... | 28 | 1.4 | 1.3 | ...... |
| 8 | ...... | 1.3 | .4 | 19 | 1.4 | .7 | ...... | 29 | 1.2 | 1.2 | ...... |
| 9 | ...... | 1.2 | .3 | 20 | 1.4 | .9 | ...... | 30 | 1.1 | 1.1 | ...... |
| 10 | ...... | 1.2 | .3 | 21 | 1.4 | 1.1 | ...... | 31 | .9 | ...... | ...... |
| 11 | ...... | 1.0 | .2 | | | | | | | | |

## McCORMICK CANAL NEAR NORTH YAKIMA, WASH.

This canal heads in the left bank of Naches River about 9 miles from North Yakima.

The gage is close to the road on the lower branch of the White & Leach canal, which supplies the McCormick canal after July 1. Measurements are made in a flume 300 feet below the gage.

*Discharge measurements of McCormick canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 22 | W. C. Muldrow | 4.75 | 1.76 | .......... | 8.4 |
| August 18 | .....do | 5.2 | 2.25 | 1.50 | 11.7 |
| September 12 | .....do | 6.8 | .70 | .95 | 4.6 |

*Daily gage height, in feet, of McCormick canal near North Yakima, Wash., for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.9 | 1.0 | 12 | ...... | 1.0 | 0.6 | 22 | 1.2 | 1.2 | ...... |
| 2 | ...... | 1.1 | 1.3 | 13 | ...... | 1.2 | .5 | 23 | 1.2 | 1.2 | ...... |
| 3 | ...... | 1.2 | 1.4 | 14 | ...... | 1.2 | .5 | 24 | 1.2 | 1.2 | ...... |
| 4 | ...... | 1.0 | 1.4 | 15 | ...... | 1.1 | .5 | 25 | 1.1 | 1.2 | ...... |
| 5 | ...... | 1.1 | 1.4 | 16 | ...... | 1.0 | ...... | 26 | 1.1 | 1.4 | ...... |
| 6 | ...... | 1.0 | .8 | 17 | ...... | 1.0 | ...... | 27 | 1.0 | 1.3 | ...... |
| 7 | ...... | .9 | .7 | 18 | 1.5 | 1.0 | ...... | 28 | 1.2 | 1.2 | ...... |
| 8 | ...... | 1.0 | .7 | 19 | 1.5 | 1.0 | ...... | 29 | 1.1 | 1.1 | ...... |
| 9 | ...... | 1.0 | .7 | 20 | 1.5 | 1.1 | ...... | 30 | 1.0 | 1.1 | ...... |
| 10 | ...... | 1.0 | .6 | 21 | 1.4 | 1.2 | ...... | 31 | .9 | ...... | ...... |
| 11 | ...... | .9 | .6 | | | | | | | | |

## NACHES-COWICHE CANAL NEAR NORTH YAKIMA, WASH.

The intake of this canal is on the right bank of Naches River just below Nelson's bridge at Painted Rocks, in sec. 9, T. 13 N., R. 18 E. About three-eighths of a mile below the intake the canal crosses Cowiche Creek and until about June 1 takes nearly all its water from this source. The amount of water taken from the river gradually increases until about August 1, after which date the entire flow of the canal is drawn from Naches River.

The gage is in a flume on T. B. Nelson's place about one-half mile below the head-gates. Measurements are made from a foot plank near the gage.

*Discharge measurements of Naches-Cowiche canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| June 22 | W. C. Muldrow | 21.7 | 1.86 | 3.09 | 40.1 |
| July 11 | do | 23.0 | 1.91 | 3.18 | 44.0 |
| August 9 | do | 22.4 | 2.01 | 3.17 | 45.0 |
| September 15 | do | 14.4 | 1.58 | 2.35 | 22.7 |
| September 29 | do | 15.0 | 1.13 | 2.10 | 16.8 |

*Daily gage height, in feet, of Naches-Cowiche canal near North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.35 | 3.25 | 3.0 | 12 | ...... | 3.35 | 3.15 | 2.65 | 22 | 3.1 | 3.25 | 3.15 | 2.3 |
| 2 | ...... | 2.35 | 3.2 | 2.75 | 13 | ...... | 3.25 | 3.2 | 2.6 | 23 | 3.0 | 3.25 | 3.15 | 2.25 |
| 3 | ...... | 2.35 | 3.2 | 3.0 | 14 | ...... | 3.25 | 3.15 | 2.25 | 24 | 2.4 | 3.25 | 3.15 | 2.3 |
| 4 | ...... | 2.35 | 3.25 | 3.0 | 15 | ...... | 3.25 | 3.15 | 2.25 | 25 | 2.4 | 3.25 | 3.15 | 2.3 |
| 5 | ...... | 2.5 | 3.25 | 3.0 | 16 | ...... | 3.25 | 3.15 | 2.25 | 26 | 2.4 | 3.25 | 3.15 | 2.15 |
| 6 | ...... | 3.0 | 3.25 | 3.0 | 17 | ...... | 3.25 | 3.15 | 2.3 | 27 | 2.5 | 3.25 | 3.15 | 2.2 |
| 7 | ...... | 3.0 | 3.25 | 2.75 | 18 | ...... | 3.25 | 3.15 | 0.0 | 28 | 2.5 | 3.25 | 3.15 | 2.15 |
| 8 | ...... | 3.1 | 3.25 | 2.75 | 19 | ...... | 3.2 | 3.15 | 2.25 | 29 | 2.5 | 3.25 | 3.1 | 2.1 |
| 9 | ...... | 3.25 | 3.25 | 2.75 | 20 | ...... | 3.2 | 3.15 | 2.25 | 30 | 2.25 | 3.25 | 3.1 | 2.1 |
| 10 | ...... | 3.25 | 3.2 | 2.75 | 21 | ...... | 3.25 | 3.15 | 2.3 | 31 | ...... | 3.25 | 3.0 | ...... |
| 11 | ...... | 3.25 | 3.25 | 2.75 | | | | | | | | | | |

## BROADGAUGE CANAL NEAR NORTH YAKIMA, WASH.

This canal is supplied from the wasteway of the Power canal. The gage is about 500 feet below the head-gates, at a bridge from which measurements are made.

*Discharge measurements of Broadgauge canal near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Dis-charge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 23 | W. C. Muldrow | 2.65 | 1.29 | ........ | 3.4 |
| August 1 | do | 8.00 | .84 | 1.25 | 6.7 |
| August 12 | do | 9.10 | .90 | 1.45 | 8.2 |
| September 29 | do | 5.60 | .69 | 1.00 | 3.9 |

*Daily gage height, in feet, of Broadgauge canal near North Yakima, Wash., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|
| 1 | | 1.5 | 1.6 | 1.0 | 1.6 | 1.35 | 0.85 |
| 2 | | 1.5 | 1.5 | 1.0 | 1.6 | 1.0 | .85 |
| 3 | | 1.25 | 1.65 | 1.45 | 1.0 | 1.0 | .85 |
| 4 | | .7 | 1.65 | 1.45 | .5 | .9 | .85 |
| 5 | | 1.6 | 1.65 | 1.75 | .75 | .9 | .85 |
| 6 | | 1.0 | 1.5 | 1.75 | 1.5 | .9 | .85 |
| 7 | | .95 | 1.75 | 1.58 | 1.5 | .9 | .85 |
| 8 | | 1.0 | 1.5 | 1.75 | 1.65 | .9 | .85 |
| 9 | | 1.45 | .35 | 1.8 | 1.5 | .9 | .85 |
| 10 | | 1.3 | .35 | 1.85 | .9 | .9 | 85 |
| 11 | | .75 | 1.5 | 1.4 | 1.65 | .9 | .9 |
| 12 | | .6 | 1.5 | 1.4 | 1.6 | .9 | .9 |
| 13 | | .6 | 1.65 | 1.35 | 1.6 | .9 | .9 |
| 14 | | .6 | 1.65 | 1.4 | 1.75 | .9 | .9 |
| 15 | | 1.0 | 1.65 | 1.4 | 1.6 | .9 | .9 |
| 16 | | 1.0 | 1.65 | 1.4 | 1.4 | .9 | .9 |
| 17 | | 1.65 | 1.65 | 1.15 | .84 | .9 | .9 |
| 18 | | 1.4 | 1.65 | 1.5 | .84 | .9 | .9 |
| 19 | | 1.75 | 1.5 | 1.35 | 1.35 | .9 | .9 |
| 20 | | 1.7 | 1.25 | 1.35 | 1.35 | .85 | .9 |
| 21 | | 1.7 | 1.25 | 1.0 | 1.35 | .85 | .9 |
| 22 | | 1.7 | 1.4 | .85 | 1.35 | .85 | .9 |
| 23 | | 1.75 | 1.0 | 1.75 | 1.35 | .85 | .9 |
| 24 | | .5 | 1.0 | 1.85 | 1.35 | .85 | .9 |
| 25 | | 1.7 | 1.15 | 1.9 | 1.35 | .85 | .9 |
| 26 | 1.4 | 1.7 | .9 | 1.85 | 1.35 | .85 | .6 |
| 27 | 1.5 | 1.5 | 1.15 | 1.85 | 1.35 | .85 | .85 |
| 28 | 1.5 | 1.5 | 1.25 | 1.85 | 1.35 | .85 | .65 |
| 29 | 1.5 | 1.5 | 1.25 | 1.75 | 1.0 | .9 | |
| 30 | 1.5 | 1.5 | 1.5 | 1.6 | 1.7 | .85 | |
| 31 | 1.5 | | 1.42 | 1.6 | | .85 | |

## POWER CANAL AT NORTH YAKIMA, WASH.

This canal heads in Naches River on its right bank in sec. 10, T. 13 N., R. 18 E., about 4 miles from North Yakima. Previous to October, 1904, it was known as the Yakima Valley Light and Power Company canal. It is now the property of the Northwestern Light and Water Company, and is the largest canal taking water from Naches River. The new company now controls also the Shanno and Broadgauge canals. These two canals and the Union canal cross the Power canal, and during the summer are supplied chiefly by it. The wasteway of this canal discharges into Yakima River.

The gage is just below the regulating gates. Measurements are made at the regulating gates and at a small flume which crosses the canal a short distance below the gage.

*Discharge measurements of Power canal at North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 23 | W. J. Lightfoot | 80 | 2.23 | 2.83 | 180 |
| August 10 | do | 75 | 2.40 | 2.85 | 180 |

*Daily gage height, in feet, of Power canal at North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.65 | 2.75 | 2.65 | 12 | ...... | 2.0 | 2.65 | 2.65 | 22 | ...... | 2.75 | 2.65 | 2.75 |
| 2 | ...... | 2.65 | 2.75 | 2.65 | 13 | ...... | 2.35 | 2.65 | 2.65 | 23 | 2.85 | 2.75 | 2.65 | 2.65 |
| 3 | ...... | 2.65 | 2.75 | 2.65 | 14 | ...... | 2.75 | 2.65 | 2.65 | 24 | 2.65 | 2.75 | 2.65 | 2.65 |
| 4 | ...... | 2.65 | 2.75 | 2.65 | 15 | ...... | 2.65 | 2.65 | 2.65 | 25 | 2.65 | 2.65 | 2.65 | 2.65 |
| 5 | ...... | 2.65 | 2.75 | 2.65 | 16 | ...... | 2.65 | 2.65 | 2.65 | 26 | 2.65 | 2.65 | 2.65 | 2.65 |
| 6 | ...... | 2.65 | 2.8 | 2.65 | 17 | ...... | 2.65 | 2.65 | 2.65 | 27 | 2.65 | 2.75 | 2.65 | 2.65 |
| 7 | ...... | 2.65 | 2.8 | 2.65 | 18 | ...... | 2.65 | 2.65 | 2.65 | 28 | 2.65 | 2.75 | 2.65 | 2.65 |
| 8 | ...... | 1.35 | 3.0 | 2.65 | 19 | ...... | 2.65 | 2.65 | 2.65 | 29 | 2.65 | 2.75 | 2.65 | 2.65 |
| 9 | ...... | 1.35 | 2.65 | 2.65 | 20 | ...... | 2.75 | 2.65 | 2.75 | 30 | 2.65 | 2.75 | 2.65 | 2.65 |
| 10 | ...... | 1.35 | 2.65 | 2.65 | 21 | ...... | 2.75 | 2.65 | 2.75 | 31 | ...... | 2.75 | 2.65 | ...... |
| 11 | ...... | 1.35 | 2.65 | 2.65 | | | | | | | | | | |

### SHANNO CANAL AT NORTH YAKIMA, WASH.

This canal is supplied from the wasteway of the Power canal. The gage is near a bridge about 1,200 feet below the head-gates. Measurements are made from a foot plank about 100 feet below the gage.

*Discharge measurements of Shanno canal at North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 12 | W. C. Muldrow | 19.5 | 1.66 | 2.10 | 32.4 |
| September 1 | do | 15.3 | 1.00 | 1.60 | 15.4 |
| September 29 | do | 10.9 | .47 | 1.25 | 5.2 |

*Daily gage height, in feet, of Shanno canal at North Yakima, Wash., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|
| 1 | ........ | 2.1 | 1.0 | 1.85 | 2.35 | 1.2 | 1.15 |
| 2 | ........ | 2.1 | 1.0 | 1.85 | 2.35 | 1.2 | 1.15 |
| 3 | ........ | 1.65 | 1.9 | 1.85 | 2.25 | 1.2 | 1.1 |
| 4 | ........ | 1.65 | 1.9 | 1.85 | 2.2 | 1.2 | 1.1 |
| 5 | ........ | 1.0 | 1.9 | 1.85 | 1.8 | 1.2 | 1.0 |
| 6 | ........ | 1.0 | 2.0 | 1.85 | 1.8 | 1.2 | 1.1 |
| 7 | ........ | 1.0 | 1.9 | 1.85 | 1.8 | 1.2 | 1.1 |
| 8 | ........ | 1.0 | 2.0 | 1.85 | 1.8 | 1.2 | 1.1 |
| 9 | ........ | 1.0 | 2.0 | 1.85 | 1.8 | 1.1 | 1.1 |
| 10 | ........ | 1.0 | 2.0 | 2.0 | 1.75 | 1.1 | 1.1 |
| 11 | ........ | 1.75 | 2.25 | 2.0 | 1.8 | 1.1 | 1.1 |
| 12 | ........ | 1.75 | 2.25 | 2.1 | 1.85 | 1.15 | 1.1 |
| 13 | ........ | 1.8 | 2.35 | 2.35 | 1.85 | 1.1 | 1.1 |
| 14 | ........ | 1.5 | 2.35 | 2.5 | 1.8 | 1.15 | 1.1 |
| 15 | ........ | 1.4 | 2.25 | 2.4 | 1.85 | 1.2 | 1.1 |
| 16 | ........ | 1.4 | 2.25 | 2.4 | 1.85 | 1.15 | 1.1 |
| 17 | ........ | 1.6 | 2.25 | 2.4 | 1.85 | 1.15 | 1.05 |
| 18 | ........ | 1.6 | 2.25 | 2.25 | 1.9 | 1.1 | 1.05 |
| 19 | ........ | 1.6 | 2.25 | 2.25 | 1.8 | 1.1 | 1.05 |
| 20 | ........ | 1.9 | 2.25 | 2.25 | 1.25 | 1.15 | 1.05 |
| 21 | ........ | 1.9 | 2.25 | 2.15 | 1.25 | 1.2 | 1.05 |

*Daily gage height, in feet, of Shanno canal at North Yakima, Wash., for 1905*—Continued.

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|
| 22 | ........ | 2.25 | 2.25 | 2.1 | 1.25 | 1.15 | 1.05 |
| 23 | ........ | 2.4 | 2.25 | 2.0 | 1.25 | 1.15 | 1.0 |
| 24 | ........ | 2.5 | 2.35 | 2.0 | 1.2 | 1.15 | 1.05 |
| 25 | ........ | 2.25 | 2.35 | 2.0 | 1.2 | 1.2 | 1.0 |
| 26 | 1.0 | 1.6 | 2.0 | 2.0 | 1.2 | 1.2 | .9 |
| 27 | 1.9 | 1.6 | 2.0 | 2.0 | 1.2 | 1.2 | [illegible] |
| 28 | 2.0 | 1.0 | 1.5 | 2.0 | 1.25 | 1.2 | 1.0 |
| 29 | 1.9 | 1.0 | 1.5 | 1.25 | 1.2 | 1.15 | ........ |
| 30 | 2.0 | 1.0 | 1.8 | 1.75 | 1.2 | 1.15 | ........ |
| 31 | 2.1 | ........ | 1.85 | 1.75 | ........ | 1.15 | ........ |

## UNION CANAL AT NORTH YAKIMA, WASH.

This canal heads in Naches River on the right bank in sec. 11, T. 13 N., R. 18 E. In sec. 13 the Union canal crosses the wasteway of the Power canal and takes some additional water from it.

The gage is just below the head-gates. Measurements are made at the end of the flume a short distance below the gage.

*Discharge measurements of Union canal at North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 11 | W. C. Muldrow | 22.0 | 2.27 | 1.66 | 50.0 |
| August 19 | do | 23.0 | 1.79 | 1.66 | 42.0 |
| September 15 | do | 24.0 | 1.30 | 1.50 | 31.2 |

*Daily gage height, in feet, of Union canal at North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.15 | 1.5 | 1.5 | 12 | ...... | 1.15 | 1.6 | 1.5 | 22 | ...... | 1.5 | 1.5 | 1.5 |
| 2 | ...... | 1.15 | 1.5 | 1.5 | 13 | ...... | 1.15 | 1.6 | 1.4 | 23 | ...... | 1.5 | 1.5 | 1.5 |
| 3 | ...... | 1.15 | 1.5 | 1.5 | 14 | ...... | 1.15 | 1.6 | 1.4 | 24 | 1.35 | 1.5 | 1.5 | 1.5 |
| 4 | ...... | 1.15 | 1.5 | 1.5 | 15 | ...... | 1.15 | 1.6 | 1.4 | 25 | 1.35 | 1.65 | 1.5 | 1.5 |
| 5 | ...... | 1.0 | 1.6 | 1.5 | 16 | ...... | 1.15 | 1.5 | 1.4 | 26 | 1.35 | 1.65 | 1.5 | 1.5 |
| 6 | ...... | 1.0 | 1.6 | 1.5 | 17 | ...... | 1.35 | 1.5 | 1.35 | 27 | 1.35 | 1.65 | 1.5 | 1.5 |
| 7 | ...... | 1.0 | 1.5 | 1.5 | 18 | ...... | 1.4 | 1.5 | 1.35 | 28 | 1.35 | 1.65 | 1.5 | 1.5 |
| 8 | ...... | 1.0 | 1.5 | 1.5 | 19 | ...... | 1.35 | 1.5 | 1.35 | 29 | 1.15 | 1.6 | 1.5 | 1.5 |
| 9 | ...... | 1.0 | 1.6 | 1.5 | 20 | ...... | 1.35 | 1.5 | 1.4 | 30 | 1.15 | 1.35 | 1.5 | 1.5 |
| 10 | ...... | 1.0 | 1.65 | 1.5 | 21 | ...... | 1.35 | 1.5 | 1.5 | 31 | ...... | 1.35 | 1.5 | ...... |
| 11 | ...... | 1.0 | 1.6 | 1.5 | | | | | | | | | | |

## TOWN CANAL AT NORTH YAKIMA, WASH.

This canal heads in Naches River in the right bank, one-eighth mile above the Northern Pacific Railway bridge and three-fourths mile above the mouth of the river.

The gage is near A. M. Cole's house, one-half mile below the headworks. Measurements are made from a foot plank near the gage.

*Discharge measurements of Town canal at North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 23 | W. C. Muldrow | 13.2 | 1.24 | 1.83 | 16.6 |
| August 11 | do | 18.4 | 1.14 | 2.17 | 21.0 |
| September 23 | do | 12.0 | 1.22 | 1.70 | 14.6 |

*Daily gage height, in feet, of Town canal at North Yakima, Wash., for 1905.*

| Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. | Day. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.85 | 1.65 | 2.05 | 12 | | 1.6 | 1.9 | 1.9 | 22 | | 2.0 | 2.5 | 1.75 |
| 2 | | 1.85 | 1.7 | 2.0 | 13 | | 1.6 | 1.9 | 1.9 | 23 | 1.85 | 2.15 | 1.9 | 1.75 |
| 3 | | 1.75 | 1.85 | 2.0 | 14 | | 2.15 | 1.75 | 1.75 | 24 | 1.9 | 2.15 | 1.75 | 1.85 |
| 4 | | 1.75 | 1.65 | 1.9 | 15 | | 2.15 | 1.6 | 1.6 | 25 | 1.85 | 2.1 | 1.6 | 1.85 |
| 5 | | 1.7 | 1.4 | 1.9 | 16 | | 2.15 | 1.4 | 1.4 | 26 | 1.85 | 1.9 | 1.4 | 1.85 |
| 6 | | 1.65 | 1.4 | 1.85 | 17 | | 2.15 | 1.35 | 1.35 | 27 | 1.85 | 1.85 | 1.5 | 1.9 |
| 7 | | 1.65 | 1.4 | 1.8 | 18 | | 2.1 | 2.5 | 1.25 | 28 | 1.9 | 0.0 | 2.4 | 1.8 |
| 8 | | 1.65 | 1.75 | 1.85 | 19 | | 2.0 | 2.5 | 1.25 | 29 | 1.9 | 1.85 | 2.05 | 1.75 |
| 9 | | 1.6 | 2.35 | 1.85 | 20 | | 2.0 | 2.5 | 1.6 | 30 | 1.85 | 1.85 | 2.1 | |
| 10 | | 2.15 | 2.35 | 1.85 | 21 | | 2.0 | 2.5 | 1.75 | 31 | | 1.65 | 2.1 | |
| 11 | | 1.9 | 2.3 | 1.85 | | | | | | | | | | |

*Miscellaneous discharge measurements of canals in Yakima River drainage basin.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 13 | Fogarty canal | Yakima River, near Ellensburg. | | | | | 30 |
| October 6 | do | do | | | | | 53 |
| July 6 | Granger canal | Yakima River, near North Yakima. | | | | | 3.6 |
| August 21 | do | do | | | | | 2.6 |
| June 24 | Upper Scott canal | Left bank upper Naches Valley. | | 8.3 | 0.88 | | 7.3 |
| August 16 | do | do | | 6.7 | .55 | | 3.7 |
| September 4 | do | do | | 8.15 | .87 | | 7.1 |
| June 24 | Cox canal | Left bank Naches River. | | 2.71 | 1.31 | | 3.6 |
| June 21 | Kelly canal | Right bank Naches River. | | 1.0 | .80 | | .8 |
| | do | do | | 3.5 | .95 | | 3.2 |
| June 24 | Laswell canal | do | | 6.0 | .58 | | 3.5 |
| June 22 | Morrisey canal | Left bank Naches River, near North Yakima. | | | | | 4.0 |
| August 18 | do | do | | | | | 4.0 |
| September 1 | R. S. & C. Co.'s canal | At power house of power canal, near North Yakima. | | | | | 4.5 |
| November 6 | do | do | | | | | 8.5 |
| September 11 | Nelson canal | Left bank of Naches River, near North Yakima. | | | | | 7.4 |

*Miscellaneous discharge measurements of canals in Yakima River drainage basin*—Contd.

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Sq. feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 7 | Union canal | Below power wasteway, in North Yakima. | | | | | 45 |
| September 15 | do | do | | | | | 10 |
| September 15 | Shanno Fruitvale canal. | Right bank Naches River, near North Yakima. | | 8.0 | 2.19 | | 17.5 |
| October 12 | do | do | | 4.0 | .70 | | 2.8 |
| September 14 | Wide hollow waste | Near Yakima | | | | | 44 |
| June 9 | Prosser power flume. | Prosser | 12 | 118 | 2.09 | 22.90 | 246 |
| August 16 | do | do | 12 | 48 | 3.86 | 17.25 | 185 |
| September 1 | do | do | 12 | 71 | 1.48 | 19.58 | 105 |
| September 14 | do | do | 12 | 82 | 2.76 | 20.25 | 225 |
| September 1 | Taylor power flume. | do | 12 | 73 | .79 | | 58 |
| September 15 | do | do | 12 | 85 | .62 | | 53 |

## KACHESS LAKE NEAR EASTON, WASH.

In order to determine the amount of storage in Kachess Lake, which is controlled by a dam at its outlet, a record of the height of the water surface was kept from September 20 to December 31, 1905.

*Daily gage height, in feet of Kachess Lake near Easton, Wash., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.1 | 0.95 | 0.45 | 12 | | 1.0 | 0.45 | 1.25 | 22 | 0.3 | 0.65 | 0.25 | 1.1 |
| 2 | | .25 | .85 | .45 | 13 | | 1.0 | .4 | 1.25 | 23 | .3 | .65 | .25 | 1.05 |
| 3 | | .6 | .8 | .45 | 14 | | .95 | .4 | 1.2 | 24 | .25 | .65 | .25 | 1.05 |
| 4 | | .8 | .8 | .4 | 15 | | .9 | .35 | 1.15 | 25 | .2 | 1.15 | .35 | 1.1 |
| 5 | | .85 | .8 | .4 | 16 | | .9 | .3 | 1.15 | 26 | .3 | 1.15 | .35 | 1.3 |
| 6 | | 1.0 | .7 | .4 | 17 | | .9 | .25 | 1.2 | 27 | .25 | 1.15 | .4 | 1.3 |
| 7 | | 1.2 | .6 | .4 | 18 | | .85 | .25 | 1.2 | 28 | .2 | 1.15 | .5 | 1.3 |
| 8 | | 1.1 | .6 | .4 | 19 | | .85 | .3 | 1.15 | 29 | .15 | 1.1 | .45 | 1.3 |
| 9 | | 1.1 | .5 | .3 | 20 | 0.4 | .75 | .45 | 1.15 | 30 | .15 | 1.2 | .45 | 1.3 |
| 10 | | 1.1 | .5 | 1.3 | 21 | .4 | .7 | .35 | 1.15 | 31 | | 1.15 | | 1.25 |
| 11 | | 1.0 | .45 | 1.3 | | | | | | | | | | |

## KACHESS RIVER NEAR EASTON, WASH.

This station was established October 14, 1903, by G. H. Bliss. It is located 2 miles northwest of Easton, Wash., and one-half mile below the foot of Lake Kachess, at the outlet of which a dam has been constructed by the Cascade Canal Company. This dam controls the flow.

The channel is straight for 600 feet above and 150 feet below the station. The current is swift. Both banks are high, wooded, and not liable to overflow. The bed of the stream is composed of gravel and rocks and is free from vegetation.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The cable has a span of 120 feet. The initial point for soundings is the south side of the aspen tree to which the cable is fastened on the left bank.

The gage is an inclined rod on the left bank directly under the cable. During 1905 the gage was read once each day by B. W. Morrow. The bench mark is the top of a large wire nail driven into the south side of the large aspen tree to which the cable is fastened on the left (north) bank. The tree is blazed and is marked "B. M." with black paint. The nail is near the base of the tree and has an elevation of 11.27 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 100, pp 385–386; 135 p 90.
**Discharge:** 100, p 386; 135, p 90.
**Discharge, monthly:** 135, p 92.
**Gage heights:** 100, p 386; 135, p 91.
**Rating table:** 135, p 91.

*Discharge measurements of Kachess River near Easton, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second* | *Feet.* | *Second-feet.* |
| April 26 | W. J. Lightfoot | 74 | 189 | 2.86 | 5.10 | 540 |
| June 2 | do | 76 | 253 | 3.68 | 6.00 | 931 |
| June 27 | do | 70 | 121 | 2.18 | 4.10 | 263 |
| August 25 | W. C. Muldrow | 70 | 113 | 2.10 | 4.00 | 238 |
| November 16 | do | 71 | 102 | 1.53 | 3.72 | 156 |

*Daily gage height, in feet, of Kachess River near Easton, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.3 | 3.55 | 3.75 | 4.45 | 5.0 | 6.0 | 4.25 | 3.4 | 3.9 | 3.6 | 4.1 | 3.85 |
| 2 | 4.3 | 3.55 | 4.0 | 2.9 | 4.8 | 6.0 | 4.2 | 3.75 | 3.9 | 3.7 | 4.05 | 3.85 |
| 3 | 4.3 | 3.55 | 4.3 | 2.9 | 4.8 | 5.8 | 4.2 | 3.75 | 3.9 | 3.85 | 4.05 | 3.85 |
| 4 | 4.25 | 3.25 | 4.6 | 2.9 | 4.7 | 5.65 | 4.2 | 3.7 | 3.95 | 4.0 | 4.05 | 3.8 |
| 5 | 4.2 | 3.25 | 4.65 | 2.9 | 3.2 | 5.5 | 4.15 | 3.65 | 4.15 | 4.1 | 4.0 | 3.8 |
| 6 | 4.1 | 3.5 | 4.8 | 2.9 | 3.1 | 5.4 | 4.15 | 3.6 | 4.1 | 4.15 | 4.0 | 3.8 |
| 7 | 4.05 | 3.5 | 4.9 | 2.9 | 3.1 | 5.25 | 3.7 | 3.55 | 4.15 | 4.2 | 3.95 | 3.8 |
| 8 | 3.95 | 3.5 | 4.95 | 2.9 | 3.1 | 5.0 | 3.65 | 3.6 | 4.15 | 4.2 | 3.95 | 3.8 |
| 9 | 3.9 | 3.5 | 5.0 | 2.9 | 3.25 | 4.7 | 3.6 | 3.7 | 4.2 | 4.2 | 3.9 | 3.75 |
| 10 | 3.85 | 3.5 | 4.8 | 2.9 | 3.25 | 4.75 | 3.6 | 3.55 | 4.2 | 4.2 | 3.9 | 3.75 |
| 11 | 3.8 | 3.5 | 4.8 | 2.9 | 3.5 | 5.0 | 3.6 | 3.5 | 4.1 | 4.2 | 3.85 | 3.75 |
| 12 | 3.75 | 3.5 | 4.85 | 5.1 | 3.6 | 4.7 | 3.6 | 3.5 | 4.05 | 4.2 | 3.85 | 3.7 |
| 13 | 3.75 | 3.5 | 4.85 | 4.8 | 3.7 | 4.75 | 3.6 | 3.45 | 4.05 | 4.2 | 3.8 | 3.7 |
| 14 | 3.8 | 3.45 | 4.9 | 4.8 | 4.0 | 4.9 | 3.6 | 3.4 | 4.0 | 4.15 | 3.75 | 3.7 |
| 15 | 3.75 | 3.45 | 4.85 | 4.8 | 4.0 | 4.85 | 3.6 | 3.4 | 3.9 | 4.1 | 3.75 | 3.65 |
| 16 | 3.7 | 3.4 | 4.8 | 4.8 | 4.1 | 4.65 | 3.6 | 3.4 | 3.85 | 4.1 | 3.75 | 3.65 |
| 17 | 3.6 | 3.4 | 4.8 | 4.8 | 4.3 | 4.3 | 3.55 | 3.4 | 3.9 | 4.1 | 3.7 | 3.7 |
| 18 | 3.15 | 3.35 | 4.8 | 4.7 | 4.25 | 4.3 | 3.55 | 3.4 | 3.85 | 4.1 | 3.7 | 3.7 |
| 19 | 3.65 | 3.45 | 4.8 | 4.65 | 4.4 | 4.3 | 3.5 | 3.4 | 3.8 | 4.05 | 3.75 | 3.7 |
| 20 | 3.6 | 3.42 | 4.8 | 4.6 | 4.4 | 4.3 | 3.5 | 3.4 | 3.8 | 4.0 | 3.75 | 3.7 |
| 21 | 3.6 | 3.43 | 4.8 | 4.7 | 4.4 | 4.3 | 3.5 | 3.4 | 3.75 | 4.0 | 3.7 | 3.65 |
| 22 | 3.6 | 3.45 | 4.8 | 4.7 | 4.4 | 4.55 | 3.5 | 3.4 | 3.7 | 3.95 | 3.7 | 3.65 |
| 23 | 3.6 | 3.45 | 4.8 | 4.8 | 4.5 | 4.3 | 3.5 | 4.0 | 3.7 | 3.95 | 3.7 | 3.6 |
| 24 | 3.6 | 3.0 | 4.8 | 4.9 | 4.75 | 3.9 | 3.5 | 4.0 | 3.7 | 3.95 | 3.7 | 3.6 |
| 25 | 3.6 | 3.5 | 4.8 | 5.0 | 4.8 | 3.85 | 3.5 | 4.0 | 3.75 | 4.2 | 3.75 | 3.65 |
| 26 | 3.6 | 3.5 | 4.75 | 5.1 | 4.8 | 3.85 | 3.5 | 4.0 | 3.7 | 4.3 | 3.8 | 3.7 |
| 27 | 3.65 | 3.55 | 4.75 | 5.2 | 4.75 | 4.1 | 3.35 | 4.0 | 3.6 | 4.3 | 3.85 | 3.75 |
| 28 | 3.65 | 3.65 | 4.75 | 5.15 | 4.9 | 4.2 | 3.3 | 3.95 | 3.65 | 4.3 | 3.85 | 3.75 |
| 29 | 3.6 | ....... | 4.6 | 5.0 | 5.6 | 4.3 | 3.5 | 3.95 | 3.6 | 4.25 | 3.85 | 3.75 |
| 30 | 3.6 | ....... | 4.55 | 5.0 | 5.5 | 4.25 | 3.4 | 4.0 | 3.6 | 4.2 | 3.85 | 3.75 |
| 31 | 3.6 | ....... | 4.5 | 5.0 | 5.65 | ....... | 3.4 | 4.0 | ....... | 4.15 | ....... | 3.7 |

NOTE.—No ice record.

*Station rating table for Kachess River near Easton, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.90 | 17 | 3.70 | 154 | 4.50 | 366 | 5.30 | 624 |
| 3.00 | 26 | 3.80 | 180 | 4.60 | 394 | 5.40 | 662 |
| 3.10 | 37 | 3.90 | 206 | 4.70 | 422 | 5.50 | 702 |
| 3.20 | 51 | 4.00 | 232 | 4.80 | 452 | 5.60 | 744 |
| 3.30 | 68 | 4.10 | 258 | 4.90 | 484 | 5.70 | 788 |
| 3.40 | 87 | 4.20 | 284 | 5.00 | 516 | 5.80 | 834 |
| 3.50 | 108 | 4.30 | 310 | 5.10 | 550 | 5.90 | 882 |
| 3.60 | 130 | 4.40 | 338 | 5.20 | 586 | 6.00 | 932 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined between gage heights 3.7 feet and 6 feet. Below 3.5 feet the table is uncertain.

*Estimated monthly discharge of Kachess River near Easton, Wash., for 1905.*

[Drainage area, 63 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 310 | 44 | 179 | 11,010 | 2.84 | 3.27 |
| February | 142 | 26 | 98.9 | 5,493 | 1.57 | 1.64 |
| March | 516 | 167 | 427 | 26,260 | 6.78 | 7.82 |
| April | 586 | 17 | 320 | 19,040 | 5.08 | 5.67 |
| May | 766 | 37 | 324 | 19,920 | 5.14 | 5.93 |
| June | 932 | 193 | 451 | 26,840 | 7.16 | 7.99 |
| July | 297 | 68 | 147 | 9,039 | 2.33 | 2.69 |
| August | 232 | 87 | 146 | 8,977 | 2.32 | 2.68 |
| September | 284 | 130 | 203 | 12,080 | 3.22 | 3.59 |
| October | 310 | 130 | 257 | 15,800 | 4.08 | 4.70 |
| November | 258 | 154 | 192 | 11,420 | 3.05 | 3.40 |
| December | 193 | 130 | 161 | 9,900 | 2.56 | 2.91 |
| The year | 932 | 17 | 242 | 175,800 | 3.84 | 52.29 |

## CLEALUM RIVER NEAR ROSLYN, WASH.

This station was established October 10, 1903, by G. H. Bliss. It is located 1,000 feet below the outlet of Lake Clealum. It is 2½ miles northwest of Roslyn and 6½ miles northwest of Clealum, Wash.

The channel is straight for 300 feet above and 900 feet below the station. The current is swift. Both banks are high, not liable to overflow, and heavily timbered. The bed of the stream is composed of gravel and is free from vegetation, and permanent.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the south face of the pine tree, 18 inches in diameter, to which the cable is fastened on the left bank.

The original gage was an inclined rod on the left bank 20 feet upstream from the cable. It was injured by flood, and August 28, 1905, was replaced by a similar gage with the datum 0.56 foot higher. All gage heights for 1905 have been reduced to the datum of the old gage. During 1905 the gage was read once each day by Charles M. Davis and E. F. Dunkin. The bench mark is a large spike driven into a root on the downstream side of the blazed tree, to which the cable is fastened, on the left bank; elevation, 17.40 feet above the zero of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 384-385; 135, pp 92-93.
Discharge: 100, p 385; 135, p 93.
Discharge, monthly: 135, p 95.
Gage heights: 100, p 385; 135, pp 93-94.
Rating table: 135, p 94.

*Discharge measurements of Clealum River near Roslyn, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 28 | W. J. Lightfoot | 134 | 1,009 | 1.94 | 4.85 | 1,963 |
| June 1 | do | 148 | 1,187 | 2.68 | 6.00 | 3,182 |
| July 20 | do | 125 | 748 | .88 | 2.52 | 659 |
| August 26 | W. C. Muldrow | 121 | 653 | .62 | 2.06 | 408 |
| September 19 | do | 75 | 127 | 2.11 | 1.62 | 268 |
| November 15 | do | 120 | 673 | .52 | 2.13 | 344 |

*Daily gage height, in feet, of Clealum River near Roslyn, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 1.4 | 2.5 | 2.4 | 4.0 | 5.9 | 3.6 | 2.45 | 1.8 | 2.15 | 2.75 | 2.15 |
| 2 | 2.05 | 1.35 | 2.8 | 2.3 | 3.7 | 5.9 | 3.6 | 2.4 | 1.75 | 2.18 | 2.65 | 2.15 |
| 3 | 2.05 | 1.35 | 3.4 | 2.2 | 3.6 | 5.7 | 3.6 | 2.35 | 1.70 | 2.65 | 2.55 | 2.1 |
| 4 | 2.0 | 1.4 | 4.05 | 1.85 | 3.5 | 5.9 | 3.5 | 2.3 | 1.7 | 4.45 | 2.5 | 2.05 |
| 5 | 1.95 | 1.4 | 4.4 | 1.75 | 3.5 | 5.5 | 3.4 | 2.3 | 1.65 | 4.46 | 2.45 | 2.05 |
| 6 | 1.85 | 1.35 | 4.4 | 1.7 | 3.8 | 5.1 | 3.35 | 2.2 | 1.65 | 4.5 | 2.35 | 2.1 |
| 7 | 1.8 | 1.35 | 4.25 | 1.6 | 4.1 | 5.0 | 3.25 | 2.15 | 1.65 | 4.3 | 2.35 | 2.1 |
| 8 | 1.75 | 1.4 | 4.2 | 1.55 | 4.7 | 5.0 | 3.15 | 2.15 | 1.6 | 4.0 | 2.3 | 2.0 |
| 9 | 1.7 | 1.4 | 4.25 | 1.6 | 5.3 | 5.3 | 3.1 | 2.15 | 1.65 | 3.65 | 2.25 | 1.95 |
| 10 | 1.6 | 1.35 | 4.2 | 1.7 | 5.0 | 5.5 | 3.1 | 2.1 | 1.65 | 3.44 | 2.2 | 1.95 |
| 11 | 1.5 | 1.3 | 4.3 | 1.8 | 4.8 | 5.5 | 3.1 | 2.15 | 1.65 | 3.2 | 2.15 | 1.9 |
| 12 | 1.5 | 1.3 | 4.4 | 2.2 | 4.2 | 5.3 | 3.0 | 2.1 | ....... | 3.05 | 2.15 | 1.85 |
| 13 | 1.45 | 1.25 | 4.4 | 2.9 | 4.1 | 5.0 | 2.9 | 2.1 | ....... | 2.85 | 2.05 | 1.85 |
| 14 | 1.4 | 1.2 | 4.1 | 3.0 | 4.2 | 4.7 | 2.85 | 2.05 | ....... | 2.8 | 2.05 | 1.8 |
| 15 | 1.5 | 1.2 | 3.9 | 3.1 | 4.4 | 4.2 | 2.7 | 2.05 | 1.65 | 2.75 | 2.05 | 1.8 |
| 16 | 1.5 | 1.15 | 3.8 | 3.3 | 4.3 | 4.1 | 2.6 | 2.0 | ....... | 2.65 | 2.00 | 1.75 |
| 17 | 1.55 | 1.15 | 3.7 | 3.2 | 4.3 | 4.0 | 2.6 | 2.05 | ....... | 2.65 | 1.95 | 1.8 |
| 18 | 1.5 | 1.1 | 3.85 | 3.1 | 4.2 | 4.0 | 2.6 | 2.3 | 1.6 | 2.55 | 1.95 | 1.8 |
| 19 | 1.45 | 1.15 | 4.0 | 3.25 | 4.1 | 4.0 | 2.6 | 2.3 | 1.6 | 2.5 | 1.9 | 1.75 |
| 20 | 1.4 | 1.2 | 4.0 | 3.4 | 3.9 | 4.0 | 2.5 | 2.25 | 1.65 | 2.45 | 2.05 | 1.75 |
| 21 | 1.4 | 1.2 | 4.0 | 3.8 | 3.8 | 4.1 | 2.5 | 2.2 | 1.68 | 2.35 | 2.05 | 1.75 |
| 22 | 1.45 | 1.2 | 3.95 | 4.1 | 3.6 | 4.1 | 2.6 | 2.1 | 1.73 | 2.3 | 2.0 | 1.75 |
| 23 | 1.4 | 1.25 | 3.9 | 4.6 | 3.6 | 4.1 | 2.6 | 2.25 | 1.75 | 2.25 | 2.0 | 1.7 |
| 24 | 1.45 | 1.35 | 3.75 | 4.7 | 3.5 | 3.9 | 2.7 | 2.2 | 1.78 | 2.3 | 1.95 | 1.7 |
| 25 | 1.4 | 1.5 | 3.3 | 5.6 | 3.4 | 3.9 | 2.6 | 2.1 | 1.82 | 3.55 | 1.95 | 1.7 |
| 26 | 1.4 | 1.8 | 3.1 | 4.8 | 3.4 | 3.8 | 2.6 | 2.0 | 1.86 | 4.25 | 2.05 | 1.75 |
| 27 | 1.45 | 2.05 | 2.9 | 5.65 | 3.8 | 3.7 | 2.6 | 1.95 | 2.05 | 4.05 | 2.15 | 1.85 |
| 28 | 1.5 | 2.25 | 2.7 | 5.3 | 4.3 | 4.0 | 2.6 | 1.9 | 2.15 | 3.65 | 2.15 | 1.8 |
| 29 | 1.5 | ....... | 2.6 | 4.7 | 4.9 | 3.8 | 2.6 | 1.9 | 2.18 | 3.4 | 2.15 | 1.8 |
| 30 | 1.45 | ....... | 2.4 | ....... | 5.0 | 3.65 | 2.52 | 1.85 | 2.18 | 3.1 | 2.15 | 1.75 |
| 31 | 1.4 | ....... | 2.3 | ....... | 5.4 | ....... | 2.45 | 1.8 | ....... | 2.9 | ....... | 1.75 |

NOTE.—No ice record.

*Station rating table for Clealum River near Roslyn, Wash., from October 10, 1903, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 140 | 2.40 | 530 | 3.70 | 1,130 | 5.00 | 2,100 |
| 1.20 | 165 | 2.50 | 565 | 3.80 | 1,185 | 5.10 | 2,190 |
| 1.30 | 190 | 2.60 | 605 | 3.90 | 1,245 | 5.20 | 2,290 |
| 1.40 | 215 | 2.70 | 645 | 4.00 | 1,310 | 5.30 | 2,390 |
| 1.50 | 240 | 2.80 | 685 | 4.10 | 1,380 | 5.40 | 2,490 |
| 1.60 | 270 | 2.90 | 725 | 4.20 | 1,450 | 5.50 | 2,590 |
| 1.70 | 300 | 3.00 | 770 | 4.30 | 1,520 | 5.60 | 2,690 |
| 1.80 | 330 | 3.10 | 815 | 4.40 | 1,590 | 5.70 | 2,790 |
| 1.90 | 360 | 3.20 | 865 | 4.50 | 1,670 | 5.80 | 2,890 |
| 2.00 | 390 | 3.30 | 915 | 4.60 | 1,750 | 5.90 | 2,990 |
| 2.10 | 425 | 3.40 | 965 | 4.70 | 1,830 | 6.00 | 3,100 |
| 2.20 | 460 | 3.50 | 1,020 | 4.80 | 1,920 | | |
| 2.30 | 495 | 3.60 | 1,075 | 4.90 | 2,010 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1905. It is well defined.

*Estimated monthly discharge of Clealum River near Roslyn, Wash., for 1905.*

[Drainage area, 205 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January [a] | 408 | 215 | 269 | 16,540 | 1.31 | 1.51 |
| February [a] | 478 | 140 | 211 | 11,720 | 1.03 | 1.07 |
| March | 1,590 | 495 | 1,155 | 71,020 | 5.63 | 6.49 |
| April | 2,740 | 255 | 1,012 | 60,220 | 4.94 | 5.51 |
| May | 2,490 | 965 | 1,450 | 89,160 | 7.07 | 8.15 |
| June | 2,990 | 1,102 | 1,841 | 109,600 | 8.98 | 10.02 |
| July | 1,075 | 548 | 733 | 45,070 | 3.58 | 4.13 |
| August | 548 | 330 | 438 | 26,930 | 2.14 | 2.47 |
| September [b] | 453 | 270 | 314 | 18,680 | 1.53 | 1.71 |
| October | 1,670 | 442 | 887 | 54,540 | 4.33 | 4.99 |
| November | 665 | 360 | 452 | 26,900 | 2.20 | 2.46 |
| December | 442 | 300 | 352 | 21,640 | 1.72 | 1.98 |
| The year | 2,990 | 140 | 760 | 552,000 | 3.70 | 50.49 |

[a] Estimates unreliable owing to probable ice conditions.
[b] Missing gage heights interpolated.

NOTE.--Low-water gage heights prior to August 28 are uncertain.

## NACHES RIVER NEAR NILE, WASH.

This station was established June 23, 1904, by G. F. Harley. It is located 1⅜ miles above the highway bridge, 23 miles northwest of North Yakima, and 8 miles southeast of Nile, Wash. The station is 1¾ miles above the junction of Naches and Tieton rivers. The channel is straight for about 600 feet above and 300 feet below the station. The current is moderate at the station and swift above and below. The right bank is low, wooded, and overflows only during extreme high floods. The left bank is high, rocky, clean, and not liable to overflow. The bed of the stream is composed of clean gravel and cobbles and is permanent. There is one channel at all except very high stages, when there are two. The section is flat and shallow.

Discharge measurements are made by means of a cable, car, and tagged wire. The cable has a span of 216 feet. The initial point for soundings is the south face of the pine on the north bank to which the cable is fastened.

An inclined staff gage is fastened to timbers buried on the left bank. During 1905 the gage was read once each day by W. H. Johnson. Bench marks were established as follows: (1) A point on the ledge 25 feet upstream from the tree supporting the cable on the north bank, marked with a cross and "B. M.;" elevation, 9.85 feet above the zero of the gage. (2) A large spike in the base of a 30-inch pine tree, 115 feet upstream from the north cable support; elevation, 8.76 feet above the zero of the gage. (3) A United States Geological Survey standard bronze tablet set in a bowlder 700 feet east of north cable support, 300 feet from the river, marked on the tablet "1661;" elevation, 1,660.824 feet above sea level and 9.20 feet above the zero of the gage.

A description of this station, with gage heights, discharge data, and rating table, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 95–97.

*Discharge measurements of Naches River near Nile, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | Feet. | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| June 20 | W. J. Lightfoot | 190 | 450 | 4.76 | 5.00 | 2,141 |
| September 5 | W. C. Muldrow | 140 | 228 | 1.41 | 3.50 | 321 |
| October 11 | do | 190 | 318 | 2.90 | 4.25 | 921 |
| October 30 | do | 187 | 259 | 2.37 | 4.00 | 615 |
| November 20 | do | 142 | 218 | 2.07 | 3.82 | 449 |

*Daily gage height, in feet, of Naches River near Nile, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.9 | 3.6 | 4.4 | 4.4 | 4.9 | 5.6 | 4.8 | 4.0 | 3.6 | 3.6 | 3.9 | 3.75 |
| 2 | 4.0 | 3.7 | 4.7 | 4.3 | 4.8 | 5.5 | 4.7 | 3.9 | 3.6 | 3.7 | 3.9 | 3.7 |
| 3 | 4.0 | 3.6 | 5.1 | 4.3 | 4.8 | 5.9 | 4.7 | 3.9 | 3.6 | 3.8 | 3.9 | 3.7 |
| 4 | 4.0 | 3.6 | 5.2 | 4.3 | 4.7 | 6.1 | 4.6 | 3.9 | 3.6 | 4.3 | 3.9 | 3.7 |
| 5 | 3.9 | 3.7 | 5.3 | 4.3 | 4.6 | 5.8 | 4.6 | 3.8 | 3.6 | 4.3 | 4.0 | 3.7 |
| 6 | 3.9 | 3.6 | 5.2 | 4.4 | 4.7 | 5.6 | 4.5 | 3.8 | 3.6 | 4.7 | 3.9 | 3.75 |
| 7 | 3.9 | 3.7 | 5.2 | 4.5 | 4.8 | 5.5 | 4.5 | 3.8 | 3.5 | 4.8 | 3.8 | 3.8 |
| 8 | 3.8 | 3.6 | 5.1 | 4.5 | 5.0 | 5.4 | 4.4 | 3.8 | 3.5 | 4.6 | 3.8 | 3.8 |
| 9 | 3.8 | 3.7 | 5.3 | 4.6 | 5.3 | 5.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | 3.7 |
| 10 | 3.6 | 3.5 | 5.4 | 4.5 | 5.1 | 5.6 | 4.4 | 3.8 | 3.5 | 4.3 | 3.8 | 3.7 |
| 11 | 3.6 | 3.5 | 5.4 | 4.5 | 4.9 | 5.5 | 4.3 | 3.7 | 3.5 | 4.2 | 3.8 | 3.65 |
| 12 | 3.7 | 3.4 | 5.3 | 4.6 | 4.8 | 5.5 | 4.2 | 3.7 | 3.5 | 4.2 | 3.7 | 3.8 |
| 13 | 3.8 | 3.4 | 5.1 | 4.6 | 4.8 | 5.4 | 4.2 | 3.7 | 3.6 | 4.1 | 3.7 | 3.75 |
| 14 | 3.8 | 3.3 | 5.0 | 4.6 | 4.9 | 5.2 | 4.1 | 3.7 | 3.6 | 4.1 | 3.7 | 3.9 |
| 15 | 3.9 | 3.3 | 4.9 | 4.5 | 4.9 | 5.1 | 4.1 | 3.7 | 3.6 | 4.1 | 3.7 | 3.85 |
| 16 | 4.0 | 3.4 | 5.0 | 4.6 | 4.9 | 5.0 | 4.1 | 3.7 | 3.5 | 4.0 | 3.7 | 3.8 |
| 17 | 3.8 | 3.4 | 5.1 | 4.5 | 5.0 | 4.9 | 4.0 | 3.8 | 3.5 | 4.0 | 3.7 | 3.75 |
| 18 | 3.8 | 3.5 | 5.2 | 4.6 | 4.9 | 4.9 | 4.0 | 3.8 | 3.6 | 4.0 | 3.7 | 3.8 |
| 19 | 3.9 | 3.7 | 5.1 | 4.6 | 4.9 | 4.8 | 3.9 | 3.7 | 3.6 | 3.9 | 3.8 | 3.7 |
| 20 | 3.8 | 3.7 | 5.1 | 4.8 | 4.8 | 4.8 | 3.9 | 3.7 | 3.5 | 3.9 | 3.9 | 3.8 |
| 21 | 3.6 | 3.8 | 5.0 | 4.9 | 4.7 | 4.8 | 4.0 | 3.7 | 3.6 | 3.9 | 3.85 | 3.7 |
| 22 | 3.6 | 3.7 | 4.9 | 4.9 | 4.7 | 4.9 | 3.9 | 3.7 | 3.6 | 3.9 | 3.8 | 3.7 |
| 23 | 3.6 | 3.8 | 4.9 | 5.0 | 4.6 | 4.8 | 4.0 | 3.7 | 3.5 | 3.9 | 3.8 | 3.6 |

*Daily gage height, in feet, of Naches River near Nile, Wash., for 1905*—**Continued.**

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 3.7 | 3.8 | 4.8 | 5.3 | 4.6 | 4.7 | 4.0 | 3.6 | 3.5 | 3.9 | 3.8 | 3.6 |
| 25 | 3.6 | 3.9 | 4.8 | 5.6 | 4.6 | 4.8 | 4.0 | 3.6 | 3.5 | 4.1 | 3.75 | 3.8 |
| 26 | 3.6 | 4.1 | 4.7 | 5.7 | 4.5 | 4.7 | 3.9 | 3.6 | 3.6 | 4.2 | 3.8 | 3.8 |
| 27 | 3.6 | 4.1 | 4.6 | 5.6 | 4.7 | 4.9 | 3.9 | 3.6 | 3.7 | 4.2 | 3.85 | 3.7 |
| 28 | 3.8 | 4.2 | 4.6 | 5.4 | 4.9 | 5.0 | 4.0 | 3.7 | 3.7 | 4.1 | 3.8 | 3.8 |
| 29 | 3.8 | ....... | 4.5 | 5.2 | 5.0 | 4.8 | 3.9 | 3.7 | 3.7 | 4.1 | 3.8 | 3.75 |
| 30 | 3.7 | ....... | 4.4 | 5.0 | 5.1 | 4.7 | 3.9 | 3.7 | 3.7 | 4.0 | 3.8 | 3.7 |
| 31 | 3.6 | ....... | 4.4 | ....... | 5.3 | ....... | 3.9 | 3.6 | ....... | 4.0 | ....... | 3.8 |

NOTE.—No ice record.

*Station rating table for Naches River near Nile, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.20 | 160 | 4.00 | 630 | 4.80 | 1,690 | 5.60 | 3,130 |
| 3.30 | 195 | 4.10 | 730 | 4.90 | 1,850 | 5.70 | 3,350 |
| 3.40 | 235 | 4.20 | 840 | 5.00 | 2,020 | 5.80 | 3,570 |
| 3.50 | 280 | 4.30 | 960 | 5.10 | 2,190 | 5.90 | 3,810 |
| 3.60 | 330 | 4.40 | 1,090 | 5.20 | 2,370 | 6.00 | 4,050 |
| 3.70 | 390 | 4.50 | 1,230 | 5.30 | 2,550 | 6.10 | 4,310 |
| 3.80 | 460 | 4.60 | 1,380 | 5.40 | 2,740 | 6.20 | 4,570 |
| 3.90 | 540 | 4.70 | 1,530 | 5.50 | 2,930 | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is fairly well defined between gage heights 3.8 feet and 5 feet.

*Estimated monthly discharge of Naches River near Nile, Wash., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 630 | 330 | 453 | 27,850 |
| February | 840 | 195 | 385 | 21,380 |
| March | 2,740 | 1,090 | 1,970 | 121,100 |
| April | 3,350 | 960 | 1,659 | 98,720 |
| May | 2,550 | 1,230 | 1,770 | 108,800 |
| June | 4,310 | 1,530 | 2,398 | 142,700 |
| July | 1,690 | 540 | 865 | 53,190 |
| August | 630 | 330 | 421 | 25,890 |
| September | 390 | 280 | 318 | 18,920 |
| October | 1,690 | 330 | 770 | 47,350 |
| November | 630 | 390 | 467 | 27,790 |
| December | 540 | 330 | 422 | 25,950 |
| The year | 4,310 | 195 | 992 | 719,600 |

## NACHES RIVER BELOW MOUTH OF TIETON RIVER, WASHINGTON.

This station was established August 4, 1905, for low-water observations. It was discontinued October 28, 1905. It is located about 500 feet below the mouth of Tieton River and 1,500 feet above the intake of Wapatox canal, near North Yakima, Wash.

The channel is straight for 500 feet above and below the station. The current is swift. Both banks are low and liable to overflow. The right bank is clean; the left wooded. The bed of the stream is composed of gravel and is permanent. There is but one channel at all stages.

Discharge measurements are made by means of a meter suspended from a light cable and operated from the bank. The initial point for soundings is a nail in the stump on the left bank to which the cable is fastened.

A vertical staff gage is spiked to a stump on the left bank. During 1905 the gage was read once each day by F. M. Johnson. The bench mark is a spike in the root of a stump 40 feet north of the initial point for soundings; elevation, 7.33 feet above the datum of the gage.

*Discharge measurements of Naches River below mouth of Tieton River, Washington, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 4 | W. J. Lightfoot | 116 | 361 | 2.13 | 3.3 | 769 |
| September 5 | W. C. Muldrow | 104 | 313 | 1.37 | 2.8 | 431 |
| October 11 | do | 119 | 433 | 2.45 | 3.8 | 1,061 |

*Daily gage height, in feet, of Naches River below mouth of Tieton River, Washington, for 1905.*

| Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. | Day. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.7 | 2.8 | 12 | 3.3 | 2.8 | 3.7 | 22 | 3.1 | 3.0 | 3.1 |
| 2 | ...... | 2.7 | 2.8 | 13 | 3.3 | 3.0 | 3.7 | 23 | 3.0 | 3.0 | 3.1 |
| 3 | ...... | 2.8 | 3.3 | 14 | 3.2 | 2.9 | 3.6 | 24 | 3.0 | 2.9 | 3.1 |
| 4 | 3.3 | 2.8 | 4.8 | 15 | 3.8 | 2.8 | 3.5 | 25 | 3.0 | 2.8 | 4.9 |
| 5 | 3.3 | 2.9 | 4.7 | 16 | 2.9 | 2.7 | 3.5 | 26 | 2.9 | 2.9 | 3.9 |
| 6 | 3.3 | 2.8 | 4.7 | 17 | 3.2 | 2.8 | 3.4 | 27 | 2.9 | 3.1 | 3.7 |
| 7 | 3.3 | 2.8 | 4.7 | 18 | 3.2 | 2.7 | 3.4 | 28 | 3.0 | 3.0 | 3.6 |
| 8 | 3.3 | 2.8 | 4.4 | 19 | 3.3 | 2.8 | 3.4 | 29 | 2.9 | 2.9 | ...... |
| 9 | 3.3 | 2.8 | 4.1 | 20 | 3.3 | 2.8 | 3.2 | 30 | 2.9 | 2.8 | ...... |
| 10 | 3.3 | 2.8 | 3.8 | 21 | 3.3 | 2.9 | 3.2 | 31 | 2.8 | ...... | ...... |
| 11 | 3.3 | 2.9 | 3.8 | | | | | | | | |

*Station rating table for Naches River below mouth of Tieton River, Washington, from August 4 to October 28, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.50 | 300 | 3.20 | 655 | 3.90 | 1,165 | 4.50 | 1,670 |
| 2.60 | 340 | 3.30 | 720 | 4.00 | 1,245 | 4.60 | 1,760 |
| 2.70 | 385 | 3.40 | 790 | 4.10 | 1,325 | 4.70 | 1,850 |
| 2.80 | 435 | 3.50 | 860 | 4.20 | 1,410 | 4.80 | 1,940 |
| 2.90 | 485 | 3.60 | 935 | 4.30 | 1,495 | 4.90 | 2,035 |
| 3.00 | 540 | 3.70 | 1,010 | 4.40 | 1,580 | 5.00 | 2,130 |
| 3.10 | 595 | 3.80 | 1,085 | | | | |

The above table is applicable only for open-channel conditions. It is based on three discharge measurements made during 1905. It is not well defined.

*Estimated monthly discharge of Naches River below mouth of Tieton River, Washington, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| August 4-31 | 1,085 | 435 | 608 | 33,770 |
| September | 595 | 385 | 459 | 27,310 |
| October 1-28 | 2,035 | 435 | 1,051 | 58,370 |

## NACHES RIVER NEAR NORTH YAKIMA, WASH.

Naches River has its source in the Cascade Mountains, Yakima County, Wash., and flows southeastward, entering Yakima River a short distance above North Yakima. Its principal tributaries are Tieton River, Cowiche, Rattlesnake, and Nile creeks, and Bumping River. The flow of the latter has already been increased by American River when it joins the Naches. Below the Tieton, almost to the point where it enters the Yakima, the Naches flows over flat bars of gravel in numerous, crooked, and constantly changing channels. These gravel bars are in some instances one-half mile in width.

Naches River is important, because of its rapid fall and the ease with which it can be used for irrigation purposes. Naches Valley, through which it flows, is already extensively irrigated from it. It is also the source of domestic water supply for the town of North Yakima and of water supply and power for the Northwestern Light and Water Company.

The original station on Naches River was established August 14, 1893, by F. H. Newell, at a point a few hundred yards above the mouth of the river, near the bridge of the Northern Pacific Railway.

The flood of November, 1896, modified the channel very greatly. On account of the instability of the channel the station was abandoned in February, 1897, though a number of discharge measurements were made during the season.

May 19, 1897, a station was established on Yakima River 5 miles above the mouth of the Naches, at the Northern Pacific Railway bridge near Selah, Wash., with the idea that the difference in discharge between this station and the one at Union Gap would give approximately the discharge of Naches River. Two ditches, located in Moxee Valley, took water out of the river between these two points, but their combined flow was about counterbalanced by that received from Atanum Creek and the Wide Hollow wastage at Old Town.

The station on Naches River was reestablished February 1, 1898, and the station at Selah, on Yakima River, was discontinued. Since the reestablishment of the Naches station the river channel has been in a condition more favorable for meter observations than formerly. September 21, 1903, the station was moved to a location between the railroad and highway bridge.

The channel is straight for 100 feet above and for 75 feet below the cable. The current is swift. Both banks are low and covered with gravel. At flood stages the rock-filled crib will prevent overflow on both banks. The bed of the stream is composed of gravel, is free from vegetation, and is somewhat shifting.

Discharge measurements are made by means of a cable, car, tagged wire, and a stay wire, 180 feet above the Northern Pacific Railway bridge and 170 feet below the highway bridge, at which discharge measurements were formerly made. The cable has a total span of 280 feet. The initial point for soundings is the south face of the cottonwood tree on the north bank, to which the cable is fastened.

The present gage, known as No. 5, is on the left bank of the river, 30 feet downstream from the railroad bridge. The lower section of the rod is inclined at an angle of 36° 30′ with the horizontal. The upper section is inclined at an angle of 80° with the horizontal.

During 1905 gage heights were observed once each day by Patrick Gallagher. This gage is referred to bench marks as follows: (1) A United States Geological Survey copper plug marked "1090 T;" elevation, 1,089.96 feet above sea level and 19.74 feet above the zero of the gage. It is located in the center of the west end of the most southerly stone pier of the railroad bridge. The elevation of the zero of the gage is 1,070.034 feet above sea level. (2) A cross in the top of the center of the downstream end of the railroad-bridge pier on the right bank. Its elevation above the zero of the gage is 19.94 feet and above sea level is 1,089.98 feet. (3) A railroad spike driven into the south side of the telegraph pole 23 feet north of the gage and 21 feet east of the railroad track. Its elevation is 17.81 feet above the zero of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

**Description:** Ann 14, ii, p 133; 18, iv, p 355; Bull 131, pp 73-74; 140, pp 244-245; WS 16, p 174; 28, p 158; 38, pp 372-373; 51, p 440; 66, p 133; 85, pp 191-192; 100, pp 379-380; 135, p 98.

**Discharge:** Ann 14, ii, p 133; 18, iv, p 355; Bull 131, pp 74, 90; 140, p 245; WS 16, p 174; 38, p 373; 51, p 440; 66, p 134; 85, p 192; 100, p 380; 135, p 101.

**Discharge, monthly:** Ann 18, iv, p 356; 20, iv, pp 499, 503; 21, iv, p 426; 22, iv, p 445; WS 75, p 202; 85, p 194; 100, p 382; 135, p 102.

**Discharge, yearly:** Ann 20, iv, p 62.

**Gage heights:** Bull 131, p 74; 140, p 245; WS 11, p 84; 16, p 174; 28, p 164; 38, p 373; 51, p 440; 66, p 134; 85, p 193; 100, p 381; 135, p 101.

**Hydrographs:** Ann 20, iv, p 503; 21, iv, p 426; 22, iv, p 446.

**Rainfall and run-off relation:** Ann 20, iv, p 500.

**Rating tables:** Ann 18, iv, p 356; WS 39, p 454; 52, p 522; 66, p 177; 85, p 193; 100, p 381; 135, p 102.

*Discharge measurements of Naches River near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 8 | W. C. Muldrow | 112 | 111 | 0.90 | 3.60 | 99 |
| September 23 | .....do | 130 | 194 | 1.37 | 4.12 | 266 |
| November 3 | .....do | 121 | 255 | 2.06 | 4.70 | 522 |
| November 17 | .....do | 121 | 241 | 1.47 | 4.32 | 355 |

*Daily gage height, in feet, of Naches River near North Yakima, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 4.6 | 5.8 | 5.6 | 6.2 | 6.9 | 6.3 | 4.6 | 3.5 | ...... | 4.8 | 4.4 |
| 2 | 5.2 | 4.6 | 6.2 | ...... | 6.1 | 6.9 | ...... | 4.5 | 3.5 | 4.1 | 4.8 | 4.4 |
| 3 | 5.2 | 4.6 | 6.8 | 5.0 | 6.0 | 7.1 | 6.1 | 4.6 | 3.6 | 4.8 | 4.7 | ...... |
| 4 | 5.2 | 4.6 | 6.8 | 5.0 | 5.8 | ...... | 6.0 | 4.7 | 3.6 | 5.1 | 4.7 | 4.4 |
| 5 | 5.1 | ...... | ...... | 5.0 | 5.8 | 7.5 | 5.8 | 4.5 | 3.6 | 5.2 | ...... | 4.4 |
| 6 | 5.1 | 4.6 | 6.8 | 5.6 | 5.8 | 7.2 | 5.7 | 4.45 | 3.7 | 5.6 | 4.7 | 4.4 |
| 7 | 5.0 | 4.6 | 6.8 | 5.6 | ...... | 7.1 | 5.6 | 4.4 | 3.6 | 6.1 | 4.7 | 4.4 |
| 8 | ...... | 4.6 | 6.8 | 5.7 | 6.2 | 7.0 | 5.6 | 4.3 | 3.6 | ...... | 4.6 | 4.4 |
| 9 | 4.9 | 4.6 | 6.8 | ...... | 6.3 | 7.1 | 5.6 | 4.3 | 3.6 | 5.6 | 4.6 | 4.4 |
| 10 | 4.8 | 4.6 | 6.9 | 5.7 | 6.4 | 7.2 | 5.6 | 4.2 | 3.6 | 5.4 | 4.5 | ...... |
| 11 | 4.7 | 4.6 | 6.9 | 5.7 | 6.2 | ...... | 5.5 | 4.2 | 3.6 | 5.3 | 4.5 | 4.1 |
| 12 | 4.7 | ...... | ...... | 5.7 | 6.1 | 7.2 | 5.4 | 4.2 | 3.7 | 5.2 | ...... | 4.1 |
| 13 | 4.6 | 4.5 | 6.8 | 5.7 | 6.0 | 7.0 | 5.3 | 4.1 | 3.8 | 5.1 | 4.5 | 4.1 |
| 14 | 4.6 | 4.5 | 6.7 | 5.7 | ...... | 6.8 | 5.1 | 4.0 | 4.0 | 5.0 | 4.4 | 4.6 |
| 15 | ...... | 4.5 | 6.5 | 5.7 | 6.2 | 6.7 | 5.0 | 4.0 | 3.9 | ...... | 4.4 | 4.3 |
| 16 | 4.8 | 4.4 | 6.5 | ...... | 6.2 | 6.6 | 5.0 | 4.0 | 3.8 | 4.9 | 4.4 | 4.3 |
| 17 | 4.8 | 4.4 | 6.5 | 5.6 | 6.2 | 6.5 | 5.0 | 3.9 | ...... | 4.9 | 4.3 | ...... |
| 18 | 4.7 | 4.4 | 6.6 | 5.6 | 6.2 | ...... | 4.9 | 3.9 | 3.8 | 4.8 | 4.3 | 4.3 |
| 19 | 4.7 | ...... | ...... | 5.6 | 6.1 | 6.3 | 4.9 | 4.4 | 3.8 | 4.8 | ...... | 4.4 |

*Daily gage height, in feet, of Naches River near North Yakima, Wash., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 4.6 | 4.6 | 6.5 | 5.7 | 6.1 | 6.3 | 4.9 | ....... | 3.8 | 4.8 | 4.5 | 4.4 |
| 21 | 4.6 | 4.6 | 6.5 | 5.9 | 6.05 | 6.3 | 4.9 | 4.1 | 4.0 | 4.7 | 4.5 | 4.4 |
| 22 | ....... | 4.6 | 6.4 | 6.0 | 6.0 | 6.3 | 5.0 | 3.9 | 4.1 | ....... | 4.4 | 4.3 |
| 23 | 4.6 | 4.8 | 6.3 | ....... | 5.9 | 6.2 | 5.0 | 3.9 | 4.1 | 4.7 | 4.4 | 4.3 |
| 24 | 4.6 | 5.0 | 6.3 | 6.4 | 5.8 | 6.2 | 5.0 | 3.8 | ....... | 4.6 | 4.4 | ..... |
| 25 | 4.6 | 5.1 | 6.2 | 6.8 | 5.7 | ....... | 4.9 | 3.7 | 4.1 | 5.0 | 4.4 | 4.3 |
| 26 | 4.6 | ....... | ....... | 7.0 | 5.7 | 6.2 | 4.8 | 3.7 | 4.1 | 5.3 | ....... | 4.4 |
| 27 | 4.6 | 5.5 | 6.1 | 6.9 | 5.8 | 6.2 | 4.7 | ....... | 4.4 | 5.2 | 4.4 | 4.4 |
| 28 | 4.6 | 5.6 | 6.0 | 6.7 | ....... | 6.5 | 4.7 | 3.6 | 4.3 | 5.1 | 4.4 | 4.3 |
| 29 | ....... | ....... | 5.9 | 6.5 | 6.1 | 6.3 | 4.7 | 3.6 | 4.2 | ....... | 4.4 | 4.2 |
| 30 | 4.6 | ....... | 5.8 | ....... | 6.4 | 6.3 | 4.65 | 3.6 | 4.0 | 4.9 | 4.4 | 4.3 |
| 31 | 4.6 | ....... | 5.7 | ....... | 6.7 | ....... | 4.6 | 3.5 | ....... | 4.8 | ....... | ..... |

*Station rating table for Naches River near North Yakima, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.50 | 100 | 4.60 | 478 | 5.60 | 1,098 | 6.60 | 2,128 |
| 3.60 | 118 | 4.70 | 530 | 5.70 | 1,174 | 6.70 | 2,255 |
| 3.70 | 139 | 4.80 | 584 | 5.80 | 1,253 | 6.80 | 2,384 |
| 3.80 | 163 | 4.90 | 640 | 5.90 | 1,339 | 6.90 | 2,515 |
| 3.90 | 190 | 5.00 | 698 | 6.00 | 1,433 | 7.00 | 2,648 |
| 4.00 | 220 | 5.10 | 758 | 6.10 | 1,535 | 7.10 | 2,785 |
| 4.10 | 254 | 5.20 | 820 | 6.20 | 1,645 | 7.20 | 2,926 |
| 4.20 | 292 | 5.30 | 884 | 6.30 | 1,762 | 7.30 | 3,071 |
| 4.30 | 334 | 5.40 | 952 | 6.40 | 1,882 | 7.40 | 3,220 |
| 4.40 | 380 | 5.50 | 1,024 | 6.50 | 2,004 | 7.50 | 3,373 |
| 4.50 | 428 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904 and 1905. It is well defined. Above gage height, 5.6 feet, the table is the same as for 1904.

*Estimated monthly discharge of Naches River near North Yakima, Wash., for 1905.*

[Drainage area, 1,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 820 | 478 | 577 | 35,480 | 0.577 | 0.665 |
| February | 1,098 | 380 | 537 | 29,820 | .537 | .559 |
| March | 2,515 | 1,174 | 1,977 | 121,600 | 1.98 | 2.28 |
| April | 2,648 | 698 | 1,371 | 81,580 | 1.37 | 1.53 |
| May | 2,255 | 1,174 | 1,518 | 93,340 | 1.52 | 1.75 |
| June | 3,373 | 1,645 | 2,276 | 135,400 | 2.28 | 2.54 |
| July | 1,762 | 478 | 882 | 54,232 | .882 | 1.02 |
| August | 530 | 100 | 268 | 16,480 | .268 | .309 |
| September | 380 | 100 | 184 | 10,950 | .184 | .205 |
| October | 1,535 | 237 | 730 | 44,890 | .730 | .842 |
| November | 584 | 334 | 432 | 25,710 | .432 | .482 |
| December | 478 | 254 | 350 | 21,520 | .350 | .404 |
| The year | 2,648 | 100 | 925 | 671,000 | .926 | 12.59 |

NOTE.—Discharge interpolated for missing gage heights.

## TIETON RIVER NEAR NORTH YAKIMA, WASH.

The gaging station on this stream was established April 14, 1902, at a point immediately below the mouth of Oak Creek, in sec. 3, T. 14 N., R. 16 E. of the Willamette meridian, about 22 miles from North Yakima by road.

The channel is straight for several hundred yards above and below the station. The banks do not overflow. The bed of the stream is rocky, with shifting gravel bars, which make it difficult to find suitable cross sections for meter measurements. There is but one channel at all stages. The underground flow at this station is estimated to be as much as 50 per cent of the measured flow.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is a cross chiseled in a ledge, with a black ring painted around it, near the west cable supports.

The gage is an inclined staff on the left bank of the stream. During 1905 it was read twice each day by Oscar Cobb. Bench marks were established as follows: (1) A point of rock on a ledge 12 feet from the gage; elevation, 15.67 feet. (2) A nail in a cottonwood stump 40 feet south of the gage; elevation, 15.93 feet. (3) The top of a bowlder 20 feet northwest of the cable-shear legs; elevation, 17.52 feet. Elevations refer to the datum of the gage, which is 1,683.36 feet above sea level.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 194; 100, p 382; 135, p 103.
Discharge: 85, p 195; 100, p 383; 135, p 103.
Discharge, monthly: 85, p 196; 100, p 384; 135, p 105.
Gage heights: 85, p 195; 135, p 104.
Rating table: 85, p 196; 100, p 384; 135, p 104.

*Discharge measurements of Tieton River near North Yakima, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 21 | W. J. Lightfoot | 111 | 178 | 3.4 | 7.90 | 605 |
| June 20 | do | 113 | 230 | 4.72 | 8.35 | 1,085 |
| September 6 | W. C. Muldrow | 109 | 126 | 2.74 | 7.20 | 325 |
| October 31 | do | 98 | 115 | 2.09 | 6.75 | 241 |
| November 20 | W. C. Sawyer | 98 | 110 | 2.16 | 6.80 | 249 |

*Daily gage height, in feet, of Tieton River near North Yakima, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7.42 | 6.85 | 8.05 | 7.62 | 8.02 | 8.95 | 8.25 | 7.62 | 6.85 | 6.78 | 6.85 | 6.58 |
| 2 | 7.35 | 6.8 | 8.6 | 7.62 | 7.92 | 9.1 | 8.2 | 7.6 | 6.98 | 7.2 | 6.85 | 6.65 |
| 3 | 7.42 | 6.82 | 8.8 | 7.6 | 7.95 | 9.8 | 8.12 | 7.6 | 7.08 | 7.9 | 6.85 | 6.62 |
| 4 | 7.38 | 6.8 | 8.8 | 7.6 | 7.88 | 9.25 | 8.07 | 7.5 | 7.12 | 7.92 | 6.85 | 6.62 |
| 5 | 7.28 | 6.88 | 8.78 | 7.62 | 7.8 | 8.92 | 8.07 | 7.42 | 7.12 | 8.4 | 6.8 | 6.62 |
| 6 | 7.15 | 6.88 | 8.72 | 7.7 | 7.9 | 8.75 | 8.0 | 7.4 | 7.1 | 8.32 | 6.78 | 6.6 |
| 7 | 7.2 | 6.85 | 8.62 | 7.72 | 8.02 | 8.68 | 7.95 | 7.55 | 7.1 | 8.0 | 6.75 | 6.64 |
| 8 | 7.1 | 6.8 | 8.6 | 7.75 | 8.35 | 8.75 | 7.95 | 7.58 | 7.12 | 7.67 | 6.7 | 6.6 |
| 9 | 6.95 | 6.8 | 8.65 | 7.72 | 8.35 | 9.05 | 8.12 | 7.62 | 7.1 | 7.45 | 6.7 | 6.58 |
| 10 | 6.85 | 6.78 | 8.7 | 7.68 | 8.2 | 9.0 | 8.18 | 7.58 | 7.1 | 7.27 | 6.7 | 6.58 |
| 11 | 6.72 | 6.48 | 8.68 | 7.65 | 8.08 | 8.98 | 7.98 | 7.55 | 7.1 | 7.2 | 6.7 | 6.55 |
| 12 | 6.7 | 6.48 | 8.52 | 7.7 | 8.02 | 8.95 | 7.85 | 7.55 | 7.15 | 7.2 | 6.58 | 6.6 |
| 13 | 6.92 | 6.7 | 8.38 | 7.8 | 8.02 | 8.7 | 7.75 | 7.48 | 7.3 | 7.07 | 6.58 | 6.6 |
| 14 | 7.02 | 6.8 | 8.32 | 7.72 | 8.12 | 8.58 | 7.65 | 7.35 | 7.12 | 7.0 | 6.55 | 6.6 |
| 15 | 7.12 | 6.78 | 8.28 | 7.7 | 8.12 | 8.53 | 7.65 | 7.22 | 7.1 | 7.03 | 6.4 | 6.58 |
| 16 | 7.08 | 6.75 | 8.3 | 7.7 | 8.2 | 8.45 | 7.6 | 7.2 | 6.95 | 6.92 | 6.7 | 6.6 |

*Daily gage height, in feet, of Tieton River near North Yakima, Wash., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 7.05 | 6.78 | 8.45 | 7.68 | 8.3 | 8.35 | 7.55 | 7.55 | 6.98 | 6.9 | 6.62 | 6.65 |
| 18 | 7.0 | 6.85 | 8.48 | 7.7 | 8.18 | 8.35 | 7.58 | 7.4 | 6.8 | 6.85 | 6.9 | 6.65 |
| 19 | 6.95 | 6.88 | 8.42 | 7.78 | 8.08 | 8.35 | 7.65 | 7.45 | 6.9 | 6.87 | 6.8 | 6.65 |
| 20 | 6.9 | 6.9 | 8.38 | 7.88 | 8.08 | 8.35 | 7.75 | 7.45 | 7.25 | 6.8 | 6.85 | 6.6 |
| 21 | 6.9 | 6.88 | 8.28 | 7.9 | 7.98 | 8.35 | 7.85 | 7.32 | 7.25 | 6.8 | 6.7 | 6.58 |
| 22 | 6.9 | 6.92 | 8.18 | 8.0 | 7.92 | 8.35 | 7.95 | 7.28 | 7.32 | 6.8 | 6.7 | 6.38 |
| 23 | 6.88 | 7.1 | 8.1 | 8.18 | 7.88 | 8.22 | 8.05 | 7.2 | 7.3 | 6.8 | 6.7 | 6.35 |
| 24 | 6.9 | 7.15 | 8.08 | 8.48 | 7.78 | 8.23 | 7.85 | 7.12 | 7.25 | 6.85 | 6.75 | 6.6 |
| 25 | 6.92 | 7.55 | 8.02 | 8.78 | 7.78 | 8.2 | 7.7 | 7.15 | 7.05 | 7.95 | 6.65 | 6.68 |
| 26 | 6.9 | 7.65 | 7.98 | 8.88 | 7.8 | 8.15 | 7.65 | 7.1 | 7.32 | 7.38 | 6.65 | 6.7 |
| 27 | 6.92 | 7.68 | 7.92 | 8.62 | 8.12 | 8.3 | 7.73 | 7.1 | 7.1 | 7.18 | 6.65 | 6.65 |
| 28 | 7.02 | 7.78 | 7.85 | 8.4 | 8.25 | 8.17 | 7.7 | 7.2 | 6.92 | 7.0 | 6.65 | 6.58 |
| 29 | 6.92 | ....... | 7.78 | 8.25 | 8.4 | 8.05 | 7.62 | 7.02 | 6.82 | 6.98 | 6.6 | 6.55 |
| 30 | 6.85 | ....... | 7.68 | 8.15 | 8.5 | 8.12 | 7.62 | 7.05 | 6.82 | 6.88 | 6.65 | 6.58 |
| 31 | 6.88 | ....... | 7.65 | ....... | 8.78 | ....... | 7.6 | 6.88 | ....... | 6.85 | ....... | 6.55 |

*Station rating table for Tieton River near North Yakima, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 6.30 | 195 | 7.20 | 335 | 8.10 | 755 | 9.00 | 1,790 |
| 6.40 | 202 | 7.30 | 365 | 8.20 | 830 | 9.10 | 1,940 |
| 6.50 | 210 | 7.40 | 400 | 8.30 | 920 | 9.20 | 2,090 |
| 6.60 | 220 | 7.50 | 440 | 8.40 | 1,020 | 9.30 | 2,240 |
| 6.70 | 233 | 7.60 | 480 | 8.50 | 1,130 | 9.40 | 2,390 |
| 6.80 | 249 | 7.70 | 525 | 8.60 | 1,250 | 9.50 | 2,540 |
| 6.90 | 267 | 7.80 | 575 | 8.70 | 1,380 | 9.60 | 2,700 |
| 7.00 | 287 | 7.90 | 630 | 8.80 | 1,510 | 9.70 | 2,860 |
| 7.10 | 310 | 8.00 | 690 | 8.90 | 1,650 | 9.80 | 3,020 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904 and 1905. It is well defined between gage heights 6.7 feet and 7.3 feet. Above gage height, 8 feet, the table is uncertain.

*Estimated monthly discharge of Tieton River near North Yakima, Wash., for 1905.*

[Drainage area, 289 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 408 | 233 | 296 | 18,200 | 1.02 | 1.18 |
| February | 565 | 208 | 292 | 16,220 | 1.01 | 1.05 |
| March | 1,510 | 502 | 1,001 | 61,550 | 3.46 | 3.99 |
| April | 1,622 | 480 | 694 | 41,300 | 2.40 | 2.68 |
| May | 1,484 | 565 | 773 | 47,530 | 2.67 | 3.08 |
| June | 3,020 | 722 | 1,304 | 77,590 | 4.51 | 5.03 |
| July | 875 | 460 | 612 | 37,630 | 2.12 | 2.44 |
| August | 489 | 263 | 394 | 24,230 | 1.36 | 1.57 |
| September | 372 | 249 | 309 | 18,390 | 1.07 | 1.19 |
| October | 1,020 | 246 | 391 | 24,040 | 1.35 | 1.56 |
| November | 267 | 202 | 236 | 14,040 | .817 | .912 |
| December | 233 | 198 | 220 | 13,530 | .761 | .877 |
| The year | 3,020 | 198 | 544 | 394,200 | 1.88 | 25.56 |

## SNAKE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Snake River is the largest tributary of the Columbia. It rises on the northern slope of the Continental Divide in the Yellowstone National Park, draining the country west and southwest of Yellowstone Lake. From Shoshone, Lewis, and Hart lakes, near its head, the river flows in a southerly direction through a timbered and mountainous country for about 20 miles, when it broadens into Jackson Lake, a deep body of water about 3 miles wide and 8 miles long. Below the lake the river flows through Jackson Hole Valley—about 40 miles long and 8 miles wide—and then enters a long canyon near the Idaho-Wyoming line. All the large tributaries come from the east, receiving their waters from the Wind River Range. The west side of the valley is bounded by the high Teton Mountains, from which most of the drainage flows westward through Teton River into North Fork of Snake River. The Snake empties into Columbia River near Pasco Junction, Wash.

Bruneau River rises in northern Nevada and flows in a general northerly course through southern Idaho, emptying into Snake River at a point south of Boise. Fall River is one of the small tributaries of Snake River at its headwaters in eastern Idaho.

Boise River drains a mountainous and well-wooded country in Elmore County, Idaho, emptying into Snake River near the point where the Snake begins to form the boundary between Idaho and Oregon. The effects of the forests are shown in the high flow that is maintained throughout the summer season, in contrast to the discharge of Weiser River, father to the west, which drains a more barren country. In the lower course of the Boise a large number of canals divert water to irrigate lands in Boise Valley. The diverson of the water is now so great that frequent complaints of scarcity are heard.

Weiser River drains Washington County, in the extreme western part of Idaho, and flows into Snake River at Weiser, Idaho.

Owyhee River rises in northwestern Nevada and flows northwestward through Idaho; Malheur River rises in the mountains of east-central Oregon and empties into Snake River west of Boise; and the Grande Ronde drains the northern slope of the Blue Mountains and empties into Snake River in southeastern Washington.

The headwater tributaries of Palouse River have their sources in western Idaho. After passing into Washington the streams unite to form Palouse River, which has a general southwesterly course, through a rolling country. Six miles below Hooper, Wash., the Palouse bends suddenly to the south and enters a canyon, through which it flows to its junction with Snake River. A short distance above the mouth of the river are the Palouse Falls, approximately 180 feet high.

### NORTH FORK OF SNAKE RIVER NEAR ORA, IDAHO.

This station was established August 20, 1902, by N. S. Dils. It is located at the North Fork Bridge, 2 miles south of Ora and 10 miles above St. Anthony, Idaho.

The channel is straight both above and below this station. The banks are high and do not overflow. The bed of the stream is hard gravel, fairly smooth, and not liable to change. The current is swift.

Discharge measurements are made from the downstream side of the bridge, which consists of four spans resting on three rock-filled crib piers. The bridge is 210 feet long. The initial point for soundings is a bolt through the toe of the end brace on the lower side of the north end of the bridge.

The gage is a vertical staff fastened to the first bridge pier from the north abutment. During 1905 the gage was read once each day by Mrs. Martha J. Fritz. Bench marks were established as follows: (1) A United States Geological Survey aluminum tablet set in a large rock about 30 feet northeast from north end of bridge; elevation, 12.84 feet. (2) A cross on a large flat rock marked "B. M.," 25 feet northeast from north end of bridge; elevation, 11.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

**Description:** WS 85, p 215; 100 p 455; 135,, p 170.
**Discharge:** WS 85, p 215; 100, p 455; 135, p 170.
**Discharge, monthly:** Ann 11, ii, p 105; WS 100, p 457; 135, p 172.
**Gage heigths:** WS 85, p 215; 100, p 456; 135, p 171.
**Rating table:** WS 100, p 456; 135, p 171.

*Discharge measurements of North Fork of Snake River near Ora, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 11 | E. C. La Rue | 178 | 393 | 3.37 | 2.30 | 1,35 |
| May 10 | do | 178 | 447 | 3.68 | 2.55 | 1,64 |
| June 28 | do | 176 | 380 | 3.12 | 2.25 | 1,18 |
| August 29 | do | 175 | 347 | 3.02 | 2.05 | 1,04 |
| September 18 | do | 174 | 360 | 2.83 | 2.05 | 1,01 |

*Daily gage height, in feet, of North Fork of Snake River near Ora, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.2 | 2.1 | 2.1 | 2.0 | 2.7 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 2 | 2.2 | 2.1 | 2.1 | 2.1 | 2.6 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 3 | 2.1 | 2.1 | 2.1 | 2.1 | 2.6 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.6 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.5 | 2.4 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 6 | 2.2 | 2.1 | 2.0 | 2.1 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 7 | 2.1 | 2.1 | 2.0 | 2.2 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 8 | 2.1 | 2.1 | 2.0 | 2.2 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 9 | 2.1 | 2.1 | 2.0 | 2.3 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 10 | 2.1 | 2.1 | 2.0 | 2.3 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 11 | 2.1 | 2.1 | 2.0 | 2.3 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 12 | 2.1 | 2.1 | 2.0 | 2.3 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 13 | 2.1 | 2.1 | 2.0 | 2.3 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 14 | 2.1 | 2.1 | 2.0 | 2.3 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 15 | 2.2 | 2.1 | 2.1 | 2.3 | 2.6 | 2.3 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 16 | 2.2 | 2.1 | 2.1 | 2.5 | 2.6 | 2.3 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 17 | 2.2 | 2.1 | 2.1 | 2.5 | 2.6 | 2.3 | 2.1 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 |
| 18 | 2.2 | 2.1 | 2.1 | 2.4 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.1 | 2.0 | 2.0 |
| 19 | 2.2 | 2.2 | 2.1 | 2.5 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.1 | 2.0 | 2.0 |
| 20 | 2.2 | 2.2 | 2.1 | 2.5 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 21 | 2.2 | 2.2 | 2.1 | 2.6 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 22 | 2.2 | 2.2 | 2.1 | 2.6 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 23 | 2.1 | 2.2 | 2.1 | 2.7 | 2.6 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 24 | 2.1 | 2.2 | 2.1 | 2.9 | 2.5 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 25 | 2.1 | 2.2 | 2.1 | 2.9 | 2.5 | 2.3 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 26 | 2.1 | 2.1 | 2.1 | 2.9 | 2.5 | 2.2 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 27 | 2.1 | 2.1 | 2.1 | 2.9 | 2.5 | 2.2 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 28 | 2.1 | 2.1 | 2.1 | 2.7 | 2.5 | 2.2 | 2.1 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| 29 | 2.1 | ....... | 2.1 | 2.7 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 | 2.0 |
| 30 | 2.1 | ....... | 2.1 | 2.7 | 2.5 | 2.2 | 2.1 | 2.0 | 2.1 | 2.0 | 2.0 | 2.0 |
| 31 | 2.1 | ....... | 2.0 | ....... | 2.5 | ....... | 2.1 | 2.0 | ....... | 2.0 | ....... | 2.0 |

NOTE.—No ice record.

*Station rating table for North Fork of Snake River near Ora, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 990 | 2.30 | 1,280 | 2.60 | 1,730 | 2.90 | 2,280 |
| 2.10 | 1,070 | 2.40 | 1,420 | 2.70 | 1,900 | 3.00 | 2,480 |
| 2.20 | 1,160 | 2.50 | 1,570 | 2.80 | 2,090 | | |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 2 feet and 2.6 feet.

*Estimated monthly discharge of North Fork of Snake River near Ora, Idaho, for 1905.*

[Drainage area, 1,040 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 1,160 | 1,070 | 1,105 | 67,940 | 1.06 | 1.22 |
| February | 1,160 | 1,070 | 1,092 | 60,650 | 1.05 | 1.09 |
| March | 1,070 | 990 | 1,039 | 63,880 | .999 | 1.15 |
| April | 2,280 | 990 | 1,517 | 90,270 | 1.46 | 1.63 |
| May | 1,900 | 1,570 | 1,663 | 102,300 | 1.60 | 1.84 |
| June | 1,570 | 1,160 | 1,345 | 80,040 | 1.29 | 1.44 |
| July | 1,160 | 1,070 | 1,085 | 66,720 | 1.04 | 1.20 |
| August | 1,070 | 990 | 1,034 | 63,580 | .994 | 1.15 |
| September | 1,070 | 990 | 995 | 59,210 | .957 | 1.07 |
| October | 1,070 | 990 | 1,039 | 63,880 | .999 | 1.15 |
| November | 990 | 990 | 990 | 58,910 | .952 | 1.06 |
| December | 990 | 990 | 990 | 60,870 | .952 | 1.10 |
| The year | 2,280 | 990 | 1,158 | 838,200 | 1.11 | 15.10 |

## SNAKE RIVER NEAR MINIDOKA, IDAHO.

This station was originally established August 5, 1895, at Montgomery's ferry, on the stage road from Minidoka to Albion, 4 miles east of Rupert, Idaho, and 10 miles below the diversion dam for the Minidoka irrigation project. Measurements at Montgomery's ferry show the amount of water available for irrigation purposes there and for the newly constructed Twin Falls canals heading 23 miles below, and also the conditions that will exist for power purposes at Shoshone Falls, about 45 miles below, after the irrigable lands of Snake River Valley shall have been reclaimed.

The channel is straight for 2,000 feet above and 1,500 feet below the station. The velocity is low at all stages. Both banks are inclined up to gage height 6 to 9 feet, and then become vertical. Both are clean, sandy, and do not overflow. The bed of the stream is composed of sand and coarse gravel and is practically permanent. There is but one channel at all stages.

Discharge measurements are made from the ferryboat. A tagged wire has been stretched above the ferry cable. The initial point for soundings is the face of the cable support on the right bank.

Since the station was established the gage has several times been disturbed by the shifting quicksand and reestablished. The present gage is a staff constructed in three independent sections on the right bank. The lower inclined section, reading from 0 to 3.3 feet, may move in the quicksand without disturbing the upper sections. Above gage height 6.6 feet the gage is vertical. During 1905 the gage was read twice each day by George Montgomery. The bench mark is a United States Geological Survey iron post on the right bank, 200 feet below the gage; elevation, 12.67 feet above the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin: WS=Water-Supply Paper):

Description: Ann 18, iv, pp 334-335; Bull 140, p 241; WS 16, p 165; 58, p 155; 38, pp 351-352; 51, p 426; 66, p 126; 85, pp 213-214; 100, p 443; 135, pp 172-173.

Discharge: Ann 18, iv, p 335; Bull 140, p 241; WS 16, p 165; 28, p 168; 38, p 352; 51, p 426; 66, p 126; 85, p 214; 100, p 444; 135, p 173.

Discharge, monthly: Ann 18, iv, p 336; 19, iv, p 447; 20, iv, pp 473, 474; 21, iv, p 405; WS 100, p 445; 135, p 175.

Discharge, yearly: Ann 20, iv, p 61.

Gage heights: Bull 140, p 231; WS 11, p 80; 16, p 165; 28, p 160; 38, p 352; 66, p 127; 85, p 214; 100, p 444; 135, pp 173-174.

Hydrographs: Ann 19, iv, p 448; 20, iv, p 475; 21, iv, p 406.

Rainfall and run-off relation: Ann 20, iv, p 744.

Rating tables: Ann 18, iv, p 335; 19, iv, p 447; WS 28, p 169; 39, p 453; 100, p 445; 135, p 174.

*Discharge measurements of Snake River near Minidoka, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 21 | E. C. La Rue | 828 | 3,938 | 1.51 | 3.10 | 5,946 |
| May 20 | do | 845 | 4,818 | 1.69 | 3.90 | 8,136 |
| June 6 | do | 850 | 5,718 | 2.14 | 5.15 | 12,220 |
| June 16 | Hoyt and La Rue | 845 | 5,588 | 2.07 | 5.05 | 11,560 |
| July 16 | E. C. La Rue | 795 | 3,212 | 1.27 | 2.40 | 4,082 |
| August 12 | do | 770 | 2,258 | .87 | 1.20 | 1,963 |
| October 23 | do | 795 | 3,269 | 1.23 | 2.31 | 4,069 |

*Daily gage height, in feet, of Snake River near Minidoka, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.45 | 3.05 | 3.05 | 2.95 | 3.9 | 4.65 | 3.75 | 1.4 | 1.2 | 1.35 | 2.4 | 2.6 |
| 2 | 4.1 | 3.05 | 3.05 | 2.9 | 3.9 | 4.65 | 3.95 | 1.4 | 1.2 | 1.4 | 2.4 | 2.75 |
| 3 | 4.0 | 2.95 | 3.15 | 2.85 | 3.9 | 4.65 | 3.75 | 1.35 | 1.15 | 1.45 | 2.4 | 2.8 |
| 4 | 3.85 | 2.9 | 3.0 | 2.75 | 3.9 | 4.8 | 3.6 | 1.3 | 1.15 | 1.55 | 2.45 | 2.55 |
| 5 | 3.65 | 2.85 | 3.0 | 2.7 | 3.95 | 5.0 | 3.5 | 1.25 | 1.2 | 1.6 | 2.5 | 2.55 |
| 6 | 3.6 | 2.75 | 3.15 | 2.7 | 4.2 | 5.1 | 3.4 | 1.2 | 1.2 | 1.65 | 2.5 | 2.55 |
| 7 | 3.5 | 2.85 | 3.25 | 2.6 | 4.2 | 5.55 | 3.35 | 1.2 | 1.2 | 1.7 | 2.5 | 2.55 |
| 8 | 3.5 | 2.9 | 3.25 | 2.6 | 4.2 | 5.6 | 3.15 | 1.2 | 1.2 | 1.75 | 2.5 | 2.55 |
| 9 | 3.5 | 3.05 | 3.05 | 2.6 | 4.1 | 5.3 | 2.95 | 1.2 | 1.2 | 1.8 | 2.5 | 2.55 |
| 10 | 3.5 | 3.05 | 2.95 | 2.7 | 4.0 | 5.0 | 2.8 | 1.2 | 1.2 | 1.85 | 2.5 | 2.8 |
| 11 | 3.35 | 3.35 | 2.95 | 2.7 | 4.0 | 5.0 | 2.7 | 1.2 | 1.2 | 1.9 | 2.5 | 3.85 |
| 12 | 3.25 | 3.8 | 2.85 | 2.8 | 4.0 | 5.35 | 2.7 | 1.2 | 1.2 | 2.0 | 2.5 | 3.65 |
| 13 | 3.3 | 4.25 | 2.85 | 2.95 | 4.0 | 5.6 | 2.6 | 1.2 | 1.2 | 2.1 | 2.5 | 3.2 |
| 14 | 3.45 | 3.75 | 2.85 | 2.95 | 4.0 | 5.35 | 2.6 | 1.2 | 1.2 | 2.15 | 2.5 | 3.1 |
| 15 | 3.55 | 3.45 | 2.85 | 2.95 | 4.0 | 5.15 | 2.5 | 1.2 | 1.2 | 2.2 | 2.5 | 3.1 |
| 16 | 3.65 | 3.2 | 2.85 | 2.95 | 4.0 | 5.05 | 2.4 | 1.2 | 1.2 | 2.25 | 2.5 | 3.1 |
| 17 | 3.8 | 3.1 | 2.85 | 2.95 | 3.9 | 5.1 | 2.3 | 1.2 | 1.15 | 2.25 | 2.5 | 3.1 |
| 18 | 3.85 | 2.9 | 2.85 | 2.95 | 3.85 | 5.25 | 2.3 | 1.2 | 1.15 | 2.25 | 2.5 | 3.1 |
| 19 | 3.95 | 3.05 | 2.85 | 2.95 | 3.8 | 5.25 | 2.15 | 1.2 | 1.15 | 2.25 | 2.5 | 3.1 |
| 20 | 4.0 | 3.35 | 2.85 | 3.05 | 3.8 | 5.15 | 2.1 | 1.2 | 1.15 | 2.25 | 2.5 | 3.2 |
| 21 | 4.15 | 3.6 | 2.85 | 3.05 | 4.25 | 4.9 | 2.0 | 1.1 | 1.15 | 2.5 | 2.6 | 3.35 |
| 22 | 4.2 | 3.8 | 2.95 | 3.05 | 4.45 | 4.6 | 2.0 | 1.15 | 1.15 | 2.4 | 2.6 | 3.4 |
| 23 | 3.9 | 2.75 | 3.0 | 3.1 | 4.6 | 4.35 | 1.9 | 1.2 | 1.15 | 2.35 | 2.6 | 3.4 |
| 24 | 3.6 | 2.85 | 2.85 | 3.25 | 4.75 | 4.1 | 1.8 | 1.2 | 1.2 | 2.3 | 2.6 | 3.4 |

*Daily gage height, in feet, of Snake River near Minidoka, Idaho, for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 3.2 | 2.85 | 2.95 | 3.25 | 4.7 | 3.95 | 1.75 | 1.2 | 1.2 | 2.3 | 2.6 | 3.4 |
| 26 | 3.05 | 2.9 | 2.95 | 3.4 | 4.5 | 3.9 | 1.7 | 1.2 | 1.2 | 2.25 | 2.6 | 3.3 |
| 27 | 3.05 | 3.05 | 3.0 | 3.6 | 4.25 | 3.85 | 1.6 | 1.2 | 1.25 | 2.25 | 2.6 | 3.0 |
| 28 | 3.05 | 3.05 | 3.05 | 3.7 | 4.15 | 3.7 | 1.5 | 1.15 | 1.25 | 2.3 | 2.6 | 2.95 |
| 29 | 3.05 | ....... | 3.05 | 3.8 | 4.3 | 3.6 | 1.5 | 1.15 | 1.25 | 2.3 | 2.6 | 3.1 |
| 30 | 3.06 | ....... | 3.05 | 3.9 | 4.35 | 3.7 | 1.45 | 1.15 | 1.25 | 2.35 | 2.6 | 3.0 |
| 31 | 3.05 | ....... | 3.05 | ....... | 4.55 | ....... | 1.4 | 1.15 | ....... | 2.4 | ....... | 3.1 |

NOTE.—The river was frozen over January 1-25; February 11-17, 20-22, and December 2, 3, 10-31.

*Station rating table for Snake River near Minidoka, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.10 | 1,880 | 2.30 | 3,940 | 3.50 | 7,060 | 4.70 | 10,580 |
| 1.20 | 1,960 | 2.40 | 4,180 | 3.60 | 7,340 | 4.80 | 10,890 |
| 1.30 | 2,060 | 2.50 | 4,430 | 3.70 | 7,630 | 4.90 | 11,210 |
| 1.40 | 2,190 | 2.60 | 4,680 | 3.80 | 7,920 | 5.00 | 11,540 |
| 1.50 | 2,340 | 2.70 | 4,930 | 3.90 | 8,210 | 5.10 | 11,880 |
| 1.60 | 2,500 | 2.80 | 5,180 | 4.00 | 8,500 | 5.20 | 12,230 |
| 1.70 | 2,670 | 2.90 | 5,440 | 4.10 | 8,790 | 5.30 | 12,590 |
| 1.80 | 2,860 | 3.00 | 5,700 | 4.20 | 9,080 | 5.40 | 12,950 |
| 1.90 | 3,060 | 3.10 | 5,970 | 4.30 | 9,380 | 5.50 | 13,320 |
| 2.00 | 3,270 | 3.20 | 6,240 | 4.40 | 9,680 | 5.60 | 13,700 |
| 2.10 | 3,480 | 3.30 | 6,510 | 4.50 | 9,980 | 5.70 | 14,090 |
| 2.20 | 3,700 | 3.40 | 6,780 | 4.60 | 10,280 | | |

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 1 foot and 5.2 feet.

*Estimated monthly discharge of Snake River near Minidoka, Idaho, for 1905.*

[Drainage area, 17,900[a] square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | ........... | ........... | 5,800 | 356,600 | 0.324 | 0.374 |
| February | ........... | ........... | 5,550 | 308,200 | .310 | .323 |
| March | 6,375 | 5,310 | 5,641 | 346,900 | .315 | .363 |
| April | 8,210 | 4,680 | 5,780 | 343,900 | .323 | .360 |
| May | 10,740 | 7,920 | 8,925 | 548,800 | .499 | .575 |
| June | 13,700 | 7,340 | 10,910 | 649,100 | .609 | .680 |
| July | 8,355 | 2,190 | 4,545 | 279,500 | .254 | .293 |
| August | 2,190 | 1,880 | 1,976 | 121,500 | .110 | .127 |
| September | 2,010 | 1,920 | 1,955 | 116,300 | .109 | .122 |
| October | 4,430 | 2,125 | 3,415 | 210,000 | .191 | .220 |
| November | 4,680 | 4,180 | 4,484 | 266,800 | .251 | .280 |
| December | ........... | ........... | 4,550 | 279,800 | .254 | .293 |
| The year | ........... | ........... | 5,294 | 3,827,000 | .296 | 4.01 |

[a] Exclusive of drainage areas of lost rivers. Revised since previous reports.

NOTE.—Monthly means for January, February, and December estimated from flow during open periods.

## LOW-WATER CONDITIONS ON SNAKE RIVER BETWEEN BLACKFOOT AND SHOSHONE FALLS, IDAHO.

The low-water conditions on Snake River, between Blackfoot and Shoshone Falls, were clearly brought out by a series of measurements made during August, 1905. This investigation was carried on by the Geological Survey in conjunction with the State engineer's office.

The entire supply of upper Snake River available above Blackfoot, Idaho, is used for irrigation during August and September. On August 10 there was 184 second-feet available at the American Falls Power Company canal heading. This canal, which diverts at a point 8 miles above Blackfoot, is to supply water for 80,000 acres of land. Beginning at a point 4 miles above the Blackfoot wagon bridge, Snake River channel was entirely dry for a distance of 10 miles. Following is a summary of the measurements:

*Low-water measurements of Snake River and Twin Falls canal in 1905.*

| Date. | Stream. | Location. | Discharge. |
|---|---|---|---|
| | | | *Second-feet.* |
| August 9 | Snake River | Just below mouth of Black River | 39 |
| August 10 | do | Just above American Falls canal heading | 184 |
| August 11 | do | Just above American Falls | 1,986 |
| August 12 | do | At Montgomery's Ferry | 1,983 |
| August 14 | do | Between Shoshone Falls and Twin Falls | [a]1,346 |
| August 15 | Twin Falls canal | | 1,008 |

[a] Includes the waste from the Twin Falls canal.

A further investigation was carried on by the United States Geological Survey to determine the loss or gain in Snake River between Montgomery's Ferry and Shoshone Falls. August 22 the discharge of Snake River between Twin Falls and Shoshone Falls was 1,299 second-feet and the discharge from springs between the point of measurement and Shoshone Falls was 17 second-feet, making the total discharge of Snake River at Shoshone Falls 1,316 second-feet.

The result of this investigation may be tabulated as follows:

*Loss in Snake River between Montgomery's Ferry and Shoshone Falls in 1905.*

| Date. | | Discharge. | |
|---|---|---|---|
| | | *Second-feet.* | *Second-feet.* |
| August 22 | Total discharge Snake River at Montgomery's Ferry | | 1,910 |
| Do | Total discharge Snake River at Shoshone Falls | 1,316 | |
| Do | Amount diverted by Twin Falls canal | 1,008 | |
| August 23 | Measured waste from Twin Falls canal reaching the river above Shoshone Falls. | | 187 |
| Do | Loss by seepage from the Twin Falls canal during the first 20 miles of its course (which is assumed to return to the river. | | 371 |
| Do | Loss in Snake River between Montgomery's Ferry and Shoshone Falls. | 144 | |
| | | 2,468 | 2,468 |

The loss of 371 second-feet in the Twin Falls canal was determined by a special series of measurements made on August 22 and 23, 1905. The canal follows the river at a distance of one-half to 1 mile from its bank, and it is therefore reasonably correct to assume that this seepage all reaches the river.

In September, 1902, a similar investigation was made and the loss between Montgomery's Ferry and Shoshone Falls was found to be 196 second-feet.

## FALL RIVER AT FREMONT, IDAHO.

This station supersedes the station at Wilson's mill, near Marysville, which was discontinued December 31, 1903, because of the difficulty of securing an observer. It was established January 1, 1904.

The channel is straight above and below the station. Both banks are high, wooded, steep, and not liable to overflow. There is but one channel at all stages. The Brady canal, capacity about 100 second-feet, heads in the right bank of the river between Wilson's mill and the Fremont station.

Discharge measurements are made by means of a cable and car. The initial point for soundings is a tin tag marked "I. P." on the inside face of the cable on the south bank of the stream.

The gage is a vertical staff on the south bank, about 900 feet from Fremont post-office. During 1905 the gage was read twice each day by Mrs. Eva A. Loomis. The bench mark is a standard aluminum tablet set in a rock 20 feet from the gage; elevation, 10.36 feet above the datum of the gage.

*Discharge measurements of Fall River at Fremont, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 12 | E. C. La Rue | 139 | 185 | 2.55 | 1.95 | 472 |
| May 11 | do | 145 | 284 | 3.75 | 2.65 | 1,065 |
| June 28 | do | 146 | 467 | 5.67 | 4.00 | 2,650 |
| August 29 | do | 140 | 178 | 2.16 | 1.85 | 384 |

*Daily gage height, in feet, of Fall River at Fremont, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 1.8 | 2.0 | 1.6 | 2.8 | 3.45 | 3.7 | 1.9 | 1.9 | 2.0 | 1.9 | 1.85 |
| 2 | 2.0 | 1.8 | 2.0 | 1.6 | 2.8 | 3.6 | 3.1 | 1.9 | 1.9 | 1.95 | 1.9 | 1.85 |
| 3 | 2.0 | 1.8 | 2.0 | 1.6 | 2.8 | 3.7 | 3.0 | 1.85 | 1.9 | 1.95 | 1.9 | 1.85 |
| 4 | 2.0 | 1.8 | 2.0 | 1.6 | 2.6 | 3.85 | 3.1 | 1.9 | 1.9 | 1.95 | 1.9 | 1.8 |
| 5 | 2.0 | 1.8 | 2.0 | 1.4 | 2.65 | 4.0 | 3.0 | 1.9 | 1.9 | 1.95 | 1.85 | 1.8 |
| 6 | 2.0 | 1.8 | 2.0 | 1.6 | 2.75 | 3.8 | 3.05 | 1.9 | 1.85 | 1.95 | 1.85 | 1.8 |
| 7 | 2.0 | 1.8 | 2.0 | 1.8 | 2.75 | 3.75 | 3.15 | 1.85 | 1.85 | 1.85 | 1.85 | 1.8 |
| 8 | 2.0 | 1.8 | 2.0 | 1.8 | 2.9 | 3.9 | 2.9 | 1.85 | 1.9 | 1.85 | 1.85 | 1.8 |
| 9 | 2.0 | 1.8 | 2.0 | 1.8 | 2.8 | 4.0 | 2.8 | 1.85 | 1.9 | 1.85 | 1.85 | 1.8 |
| 10 | 2.0 | 1.8 | 2.0 | 1.8 | 2.7 | 4.05 | 3.05 | 1.85 | 1.9 | 1.85 | 1.85 | ...... |
| 11 | 2.0 | 1.8 | 2.0 | 1.6 | 2.7 | 3.75 | 2.7 | 1.85 | 1.9 | 1.85 | 1.85 | ...... |
| 12 | 2.0 | ....... | 1.8 | 1.8 | 2.65 | 3.6 | 2.8 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 13 | 2.0 | ....... | 1.8 | 1.8 | 2.65 | 3.75 | 2.75 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 14 | 2.0 | ....... | 1.8 | 1.8 | 2.75 | 3.85 | 2.65 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 15 | 2.0 | ....... | 1.8 | 1.8 | 2.75 | 3.75 | 2.35 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 16 | 2.0 | ....... | 1.8 | 1.8 | 2.8 | 3.6 | 2.25 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 17 | 1.8 | ....... | 1.8 | 2.0 | 2.9 | 3.5 | 2.15 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 18 | 1.8 | ....... | 1.8 | 2.0 | 3.2 | 3.6 | 2.1 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 19 | 1.8 | ....... | 1.8 | 2.1 | 3.25 | 3.1 | 2.1 | 1.85 | 1.9 | 1.85 | 1.85 | ...... |
| 20 | 1.8 | ....... | 1.8 | 2.2 | 3.2 | 2.9 | 2.1 | 1.85 | 1.9 | 1.85 | 1.85 | ...... |

*Daily gage height, in feet, of Fall River at Fremont, Idaho, for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 1.8 | ....... | 1.6 | 2.25 | 3.2 | 2.85 | 2.05 | 1.85 | 1.85 | 1.9 | 1.85 | ...... |
| 22 | 1.8 | ....... | 1.6 | 2.3 | 3.25 | 3.1 | 2.0 | 1.85 | 1.85 | 1.9 | 1.85 | ...... |
| 23 | 1.8 | ....... | 1.6 | 2.4 | 3.5 | 3.15 | 1.95 | 1.85 | 1.85 | 1.9 | 1.85 | ...... |
| 24 | 1.8 | ....... | 1.6 | 2.5 | 2.85 | 3.2 | 1.9 | 1.85 | 1.9 | 1.9 | 1.85 | ...... |
| 25 | 1.8 | ....... | 1.6 | 2.95 | 2.9 | 3.3 | 1.9 | 1.85 | 1.95 | 1.9 | 1.85 | ...... |
| 26 | 1.8 | ....... | 1.6 | 3.5 | 3.0 | 3.5 | 1.9 | 1.9 | 1.95 | 1.9 | 1.85 | ...... |
| 27 | 1.8 | ....... | 1.6 | 2.9 | 3.2 | 3.9 | 1.9 | 1.9 | 1.95 | 1.9 | 1.85 | ...... |
| 28 | 1.8 | ....... | 1.6 | 2.7 | 3.35 | 4.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.85 | ...... |
| 29 | 1.8 | ....... | 1.6 | 2.75 | 3.6 | 3.8 | 1.8 | 1.9 | 1.9 | 1.9 | 1.85 | ...... |
| 30 | 1.8 | ....... | 1.6 | 2.8 | 3.5 | 3.6 | 1.9 | 1.9 | 2.0 | 1.9 | 1.85 | ...... |
| 31 | 1.8 | ....... | 1.6 | ....... | 3.45 | ....... | 1.9 | 1.9 | ....... | 1.9 | ....... | ...... |

NOTE.—River frozen over February 12-28 and December 12-31.

*Station rating table for Fall River at Fremont, Idaho, from October 28, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 168 | 2.10 | 575 | 2.80 | 1,215 | 3.50 | 2,030 |
| 1.50 | 210 | 2.20 | 655 | 2.90 | 1,325 | 3.60 | 2,150 |
| 1.60 | 255 | 2.30 | 740 | 3.00 | 1,440 | 3.70 | 2,275 |
| 1.70 | 305 | 2.40 | 825 | 3.10 | 1,555 | 3.80 | 2,400 |
| 1.80 | 365 | 2.50 | 915 | 3.20 | 1,670 | 3.90 | 2,525 |
| 1.90 | 430 | 2.60 | 1,010 | 3.30 | 1,790 | 4.00 | 2,650 |
| 2.00 | 500 | 2.70 | 1,110 | 3.40 | 1,910 | | |

The above table is applicable only for open-channel conditions. It is based on four discharge measurements made during 1905. It is not well defined.

*Estimated monthly discharge of Fall River at Fremont, Idaho, for 1904.*

[Drainage area, 390 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| November | 575 | 500 | 532 | 31,660 | 1.36 | 1.52 |
| December | 538 | 500 | 510 | 31,360 | 1.31 | 1.51 |

*Estimated monthly discharge of Fall River at Fremont, Idaho, for 1905.*

[Drainage area, 390 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 500 | 365 | 435 | 26,750 | 1.12 | 1.29 |
| February 1-11 | 365 | 365 | 365 | 7,964 | .936 | .383 |
| March | 500 | 255 | 374 | 23,000 | .959 | 1.11 |
| April | 2,030 | 168 | 620 | 36,890 | 1.59 | 1.77 |
| May | 2,150 | 1,010 | 1,419 | 87,250 | 3.64 | 4.20 |
| June | 2,712 | 1,270 | 2,154 | 128,200 | 5.52 | 6.16 |
| July | 2,275 | 365 | 924 | 56,820 | 2.37 | 2.73 |
| August | 430 | 398 | 409 | 25,150 | 1.05 | 1.21 |
| September | 500 | 398 | 430 | 25,590 | 1.10 | 1.23 |
| October | 500 | 398 | 431 | 26,500 | 1.11 | 1.28 |
| November | 430 | 398 | 402 | 23,920 | 1.03 | 1.15 |
| December 1-9 | 398 | 365 | 376 | 6,712 | .964 | .323 |
| The period | | | | 474,700 | | |

NOTE.—No estimate for ice period.

## TETON RIVER NEAR ST. ANTHONY, IDAHO.

This station was established April 23, 1903, by N. S. Dils. It is located at the bridge on the stage road from St. Anthony to Victor, Idaho.

The channel is straight for a short distance above and below the station. The right bank is high and will not overflow. The left bank will overflow at extreme flood stages. The current is sluggish. Both banks and bed are composed of hard gravel, and the latter is permanent.

Discharge measurements are made from the two-span bridge to which the gage is attached. The bridge is supported by crib abutments, constructed of logs and filled with lava rock, and by a similar middle pier. The initial point from which soundings are made is a large bolt marked "I. P." in the upstream side of the south abutment.

The gage is a vertical staff spiked to the upstream side of the north abutment of the bridge. During 1905 the gage was read once each day by William Ferguson. Bench marks were established as follows: (1) A United States Geological Survey aluminum tablet set in solid rock about 30 feet northeast of the north end of the bridge; elevation, 13.53 feet. (2) A cross on a large flat rock 40 feet northeast of the right end of the bridge, marked "B. M."; elevation, 14.25 feet. (3) A similar rock 60 feet northwest of the right end of the bridge, similarly marked; elevation, 14.41 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 453; 135, p 177.
Discharge: 100, p 453; 135, p 177.
Discharge, monthly: 100, p 455; 135, p 179.
Gage heights: 100, p 454; 135, p 178.
Rating table: 100, p 454; 135, p 178.

*Discharge measurements of Teton River near St. Anthony, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 13 | E. C. La Rue | 81 | 306 | 1.22 | 1.50 | 371 |
| May 12 | do | 80 | 349 | 1.86 | 1.95 | 649 |
| June 14 | do | 80 | 457 | 3.29 | 3.10 | 1,504 |
| June 29 | do | 80 | 407 | 2.78 | 2.60 | 1,131 |
| August 28 | do | 79.5 | 322 | 1.49 | 1.70 | 478 |

*Daily gage height, in feet, of Teton River near St. Anthony, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.1 | 1.4 | 1.3 | 1.4 | 1.85 | 3.15 | 2.55 | 1.7 | 1.65 | 1.5 | 1.5 | 1.6 |
| 2 | 2.0 | 1.4 | 1.3 | 1.45 | 1.95 | 3.25 | 2.45 | 1.7 | 1.65 | 1.5 | 1.5 | 1.65 |
| 3 | 2.0 | 1.4 | 1.3 | 1.5 | 1.9 | 3.4 | 2.4 | 1.7 | 1.65 | 1.5 | 1.5 | 1.65 |
| 4 | 1.95 | 1.4 | 1.3 | 1.5 | 1.95 | 3.4 | 2.35 | 1.7 | 1.65 | 1.5 | 1.5 | 1.65 |
| 5 | 1.95 | 1.4 | 1.35 | 1.5 | 2.0 | 3.4 | 2.3 | 1.7 | 1.65 | 1.5 | 1.5 | 1.65 |
| 6 | 1.95 | 1.4 | 1.35 | 1.55 | 2.0 | 3.1 | 2.3 | 1.7 | 1.65 | 1.5 | 1.5 | 1.55 |
| 7 | 1.95 | 1.4 | 1.4 | 1.6 | 2.05 | 3.1 | 2.3 | 1.7 | 1.6 | 1.5 | 1.5 | 1.55 |
| 8 | 1.95 | 1.4 | 1.4 | 1.6 | 2.1 | 3.1 | 2.25 | 1.7 | 1.6 | 1.5 | 1.5 | 1.6 |
| 9 | 1.95 | 1.4 | 1.4 | 1.55 | 2.15 | 3.2 | 2.25 | 1.7 | 1.6 | 1.5 | 1.5 | 1.6 |
| 10 | 1.95 | 1.4 | 1.4 | 1.5 | 2.15 | 3.25 | 2.25 | 1.65 | 1.6 | 1.5 | 1.5 | 1.6 |
| 11 | 2.0 | 1.6 | 1.4 | 1.55 | 2.1 | 2.9 | 2.25 | 1.65 | 1.6 | 1.5 | 1.5 | 1.7 |
| 12 | 2.1 | 1.95 | 1.4 | 1.5 | 2.0 | 2.9 | 2.2 | 1.6 | 1.55 | 1.5 | 1.5 | ...... |
| 13 | 2.1 | 1.95 | 1.5 | 1.5 | 1.85 | 3.0 | 2.2 | 1.6 | 1.55 | 1.5 | 1.5 | ...... |
| 14 | 2.1 | 1.95 | 1.6 | 1.5 | 1.9 | 3.0 | 2.15 | 1.6 | 1.55 | 1.5 | 1.5 | ...... |
| 15 | 2.1 | 2.0 | 1.7 | 1.5 | 1.95 | 3.0 | 2.1 | 1.6 | 1.5 | 1.5 | 1.5 | ...... |
| 16 | 2.1 | 2.0 | 1.9 | 1.5 | 2.1 | 3.0 | 2.05 | 1.55 | 1.5 | 1.5 | 1.5 | ...... |
| 17 | 2.15 | 2.3 | 2.0 | 1.5 | 2.4 | 2.8 | 2.0 | 1.55 | 1.5 | 1.5 | 1.5 | ...... |
| 18 | 2.15 | 2.5 | 2.2 | 1.5 | 2.55 | 2.7 | 1.95 | 1.55 | 1.5 | 1.5 | 1.5 | ...... |
| 19 | 2.15 | 2.5 | 2.1 | 1.5 | 2.7 | 2.7 | 1.9 | 1.55 | 1.5 | 1.5 | 1.5 | ...... |
| 20 | 2.15 | 2.6 | 1.95 | 1.55 | 2.75 | 2.6 | 1.9 | 1.55 | 1.5 | 1.55 | 1.5 | ...... |
| 21 | 2.15 | 2.6 | 1.8 | 1.6 | 2.8 | 2.4 | 1.85 | 1.55 | 1.5 | 1.55 | 1.5 | ...... |
| 22 | 2.1 | 2.5 | 1.75 | 1.6 | 2.8 | 2.4 | 1.85 | 1.6 | 1.45 | 1.55 | 1.5 | ...... |
| 23 | 2.0 | 2.5 | 1.65 | 1.6 | 2.4 | 2.4 | 1.8 | 1.6 | 1.45 | 1.55 | 1.5 | ...... |
| 24 | 1.8 | 2.45 | 1.6 | 1.75 | 2.3 | 2.4 | 1.75 | 1.6 | 1.45 | 1.55 | 1.5 | ...... |
| 25 | 1.7 | 2.4 | 1.5 | 1.9 | 2.25 | 2.4 | 1.75 | 1.65 | 1.45 | 1.55 | 1.5 | ...... |
| 26 | 1.4 | 1.3 | 1.8 | 1.8 | 2.45 | 2.4 | 1.75 | 1.65 | 1.45 | 1.5 | 1.5 | ...... |
| 27 | 1.4 | 1.3 | 1.9 | 1.7 | 2.7 | 2.4 | 1.75 | 1.65 | 1.45 | 1.5 | 1.5 | ...... |
| 28 | 1.4 | 1.3 | 1.8 | 1.7 | 2.9 | 2.45 | 1.7 | 1.65 | 1.45 | 1.5 | 1.5 | ...... |
| 29 | 1.4 | ...... | 1.75 | 1.7 | 3.05 | 2.6 | 1.7 | 1.65 | 1.55 | 1.5 | 1.55 | ...... |
| 30 | 1.4 | ...... | 1.6 | 1.8 | 2.8 | 2.6 | 1.7 | 1.65 | 1.55 | 1.5 | 1.55 | ...... |
| 31 | 1.4 | ...... | 1.5 | ...... | 2.95 | ...... | 1.7 | 1.65 | ...... | 1.5 | ...... | ...... |

NOTE.—River frozen over January 1 to February 28, and December 12 to 31.

*Station rating table for Teton River near St. Anthony, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet* |
| 1.30 | 253 | 1.90 | 610 | 2.50 | 1,024 | 3.00 | 1,417 |
| 1.40 | 310 | 2.00 | 674 | 2.60 | 1,100 | 3.10 | 1,500 |
| 1.50 | 368 | 2.10 | 740 | 2.70 | 1,177 | 3.20 | 1,584 |
| 1.60 | 427 | 2.20 | 808 | 2.80 | 1,255 | 3.30 | 1,669 |
| 1.70 | 487 | 2.30 | 878 | 2.90 | 1,335 | 3.40 | 1,755 |
| 1.80 | 548 | 2.40 | 950 | | | | |

The above table is strictly applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 1.5 feet and 3.1 feet.

*Estimated monthly discharge of Teton River near St. Anthony, Idaho, for 1905.*

[Drainage area, 960 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March | 808 | 253 | 438 | 26,930 | 0.456 | 0.526 |
| April | 610 | 310 | 416 | 24,750 | .433 | .483 |
| May | 1,458 | 579 | 902 | 55,460 | .940 | 1.08 |
| June | 1,755 | 950 | 1,301 | 77,420 | 1.36 | 1.52 |
| July | 1,062 | 487 | 710 | 43,660 | .740 | .853 |
| August | 487 | 398 | 448 | 27,550 | .467 | .538 |
| September | 457 | 339 | 394 | 23,440 | .410 | .457 |
| October | 398 | 368 | 374 | 23,000 | .390 | .450 |
| November | 398 | 368 | 370 | 22,020 | .385 | .430 |
| December 1-11 | 487 | 398 | 438 | 9,556 | .456 | .187 |
| The period | | | | 333,800 | | |

NOTE.—No estimate for ice period.

## SOUTH FORK OF SNAKE RIVER AT MORAN, WYO.

This station was established September 21, 1903, by Fred Stockton. It is located directly back of the post-office at Moran, Wyo., and about three-fourths of a mile below the outlet of Jackson Lake.

The channel is slightly curved for about 300 feet above the station. Below the station the channel is straight. At and above the station the current is smooth and has a well-distributed velocity. Below the station the current is broken by small bowlders. Both banks are high and are not liable to overflow. The right bank is wooded and the left bank is composed of gravel and is without trees. The bed of the stream is composed of firm gravel. There is but one channel at all stages.

Discharge measurements are made from a cable and car about 150 feet below the gage. The initial point for soundings is on the inner face of cable support on north side of river.

The gage is an inclined staff. During 1905 it was read once each day by Lizzie Roche and Maria Allen. The bench mark is a United States Geological Survey iron bench-mark post set about 30 feet from the gage; elevation, 10.77 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 452; 135, pp 179-180.
Discharge: 100, pp 452, 461; 135, p 180.
Discharge, monthly: 135, p 181.
Gage heights: 100, p 453; 135, p 180.
Rating table: 135, p 181.

*Discharge measurements of South Fork of Snake River at Moran, Wyo., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 3 | E. C. La Rue | 202 | 910 | 3.60 | 4.10 | 3,276 |
| August 19 | Charles B. Smith | 196 | 496 | 1.69 | 1.75 | 837 |

*Daily gage height, in feet, of South Fork of Snake River at Moran, Wyo., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9 | 1.3 | 1.2 | 1.25 | 1.65 | 4.05 | 4.2 | 2.35 | 1.6 | 1.2 | 0.9 | 0.9 |
| 2 | .9 | 1.3 | 1.2 | 1.25 | 1.65 | 4.2 | 4.15 | 2.35 | 1.6 | 1.2 | .9 | .9 |
| 3 | .9 | 1.3 | 1.15 | 1.25 | 1.65 | 4.3 | 4.1 | 2.3 | 1.55 | 1.2 | .9 | .9 |
| 4 | .9 | 1.3 | 1.15 | 1.25 | 1.65 | 4.35 | 4.1 | 2.3 | 1.5 | 1.15 | .9 | .9 |
| 5 | .9 | 1.3 | 1.15 | 1.25 | 1.7 | 4.4 | 3.95 | 2.25 | 1.5 | 1.15 | .9 | .9 |
| 6 | .9 | 1.3 | 1.15 | 1.25 | 1.7 | 4.45 | 3.95 | 2.25 | 1.5 | 1.15 | .9 | .9 |
| 7 | .9 | 1.25 | 1.15 | 1.25 | 1.7 | 4.6 | 3.9 | 2.25 | 1.5 | 1.15 | .9 | .9 |
| 8 | .9 | 1.25 | 1.15 | 1.25 | 1.75 | 5.0 | 3.8 | 2.25 | 1.45 | 1.15 | .9 | .9 |
| 9 | .9 | 1.25 | 1.15 | 1.25 | 1.8 | 5.1 | 3.7 | 2.2 | 1.45 | 1.1 | .9 | .9 |
| 10 | .9 | 1.25 | 1.15 | 1.25 | 1.85 | 5.15 | 3.55 | 2.2 | 1.45 | 1.1 | .9 | .9 |
| 11 | .9 | 1.2 | 1.15 | 1.25 | 1.9 | 5.05 | 3.5 | 2.2 | 1.45 | 1.1 | .9 | .9 |
| 12 | .9 | 1.2 | 1.15 | 1.25 | 1.9 | 5.05 | 3.4 | 2.2 | 1.4 | 1.1 | .9 | .9 |
| 13 | .9 | 1.2 | 1.15 | 1.25 | 1.9 | 5.0 | 3.35 | 2.0 | 1.35 | 1.1 | .9 | .9 |
| 14 | .9 | 1.2 | 1.15 | 1.25 | 1.95 | 5.05 | 3.3 | 1.9 | 1.3 | 1.1 | .9 | .9 |
| 15 | .9 | 1.2 | 1.15 | 1.3 | 1.95 | 5.15 | 3.25 | 1.85 | 1.3 | 1.1 | .9 | .9 |
| 16 | .9 | 1.2 | 1.15 | 1.3 | 1.95 | 5.1 | 3.25 | 1.85 | 1.25 | 1.1 | .9 | .9 |
| 17 | .9 | 1.2 | 1.15 | 1.35 | 2.0 | 5.1 | 3.25 | 1.85 | 1.25 | 1.1 | 1.0 | .9 |
| 18 | .9 | 1.2 | 1.15 | 1.35 | 2.1 | 5.05 | 3.15 | 1.75 | 1.25 | 1.1 | 1.0 | .9 |
| 19 | .9 | 1.2 | 1.15 | 1.4 | 2.3 | 5.0 | 3.1 | 1.75 | 1.2 | 1.2 | .9 | .9 |
| 20 | .9 | 1.2 | 1.15 | 1.4 | 2.3 | 4.85 | 3.05 | 1.75 | 1.2 | 1.1 | .9 | .9 |
| 21 | .9 | 1.2 | 1.2 | 1.4 | 2.3 | 4.65 | 2.9 | 1.75 | 1.2 | 1.1 | .9 | .9 |
| 22 | .9 | 1.2 | 1.2 | 1.45 | 2.4 | 4.5 | 2.9 | 1.75 | 1.2 | 1.1 | .9 | .9 |
| 23 | .9 | 1.2 | 1.25 | 1.45 | 2.45 | 4.45 | 2.8 | 1.7 | 1.2 | 1.1 | .9 | .9 |
| 24 | .9 | 1.2 | 1.25 | 1.45 | 2.5 | 4.35 | 2.7 | 1.7 | 1.2 | 1.1 | .9 | .9 |
| 25 | .9 | 1.2 | 1.25 | 1.5 | 2.55 | 4.35 | 2.6 | 1.7 | 1.2 | 1.05 | .9 | .9 |
| 26 | 1.0 | 1.2 | 1.25 | 1.55 | 2.6 | 4.35 | 2.55 | 1.7 | 1.2 | 1.05 | .9 | .9 |
| 27 | 1.0 | 1.2 | 1.25 | 1.55 | 2.7 | 4.35 | 2.55 | 1.75 | 1.25 | 1.05 | .9 | .9 |
| 28 | 1.1 | 1.2 | 1.25 | 1.6 | 3.0 | 4.35 | 2.55 | 1.7 | 1.25 | 1.0 | .9 | .9 |
| 29 | 1.2 | ....... | 1.25 | 1.6 | 3.05 | 4.3 | 2.45 | 1.7 | 1.25 | 1.0 | .9 | .9 |
| 30 | 1.2 | ....... | 1.25 | 1.65 | 3.35 | 4.25 | 2.45 | 1.65 | 1.25 | 1.0 | .9 | .9 |
| 31 | 1.3 | ....... | 1.25 | ....... | 3.8 | ....... | 2.4 | 1.65 | ....... | 1.0 | ....... | .9 |

NOTE.—No ice record.

*Station rating table for South Fork of Snake River at Moran, Wyo., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.00 | 107 | 1.40 | 653 | 2.70 | 1,679 | 4.00 | 3,145 |
| 0.10 | 126 | 1.50 | 719 | 2.80 | 1,772 | 4.20 | 3,420 |
| 0.20 | 147 | 1.60 | 788 | 2.90 | 1,868 | 4.40 | 3,715 |
| 0.30 | 171 | 1.70 | 859 | 3.00 | 1,967 | 4.60 | 4,130 |
| 0.40 | 197 | 1.80 | 932 | 3.10 | 2,070 | 4.80 | 4,365 |
| 0.50 | 225 | 1.90 | 1,007 | 3.20 | 2,175 | 5.00 | 4,720 |
| 0.60 | 256 | 2.00 | 1,084 | 3.30 | 2,285 | 5.20 | 5,080 |
| 0.70 | 291 | 2.10 | 1,163 | 3.40 | 2,400 | 5.40 | 5,450 |
| 0.80 | 330 | 2.20 | 1,244 | 3.50 | 2,515 | 5.60 | 5,830 |
| 0.90 | 374 | 2.30 | 1,327 | 2.60 | 2,635 | 5.80 | 6,220 |
| 1.00 | 422 | 2.40 | 1,412 | 3.70 | 2,760 | 6.00 | 6,620 |
| 1.10 | 474 | 2.50 | 1,499 | 3.80 | 2,885 | 6.20 | 7,025 |
| 1.20 | 530 | 2.60 | 1,588 | 3.90 | 3,015 | 6.40 | 7,440 |
| 1.30 | 590 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1903–1905. It is not well defined.

*Estimated monthly discharge of South Fork of Snake River at Moran, Wyo., for 1905.*

[Drainage area, 820 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 590 | 374 | 397 | 24,410 | 0.484 | 0.558 |
| February | 590 | 530 | 547 | 30,380 | .667 | .695 |
| March | 560 | 502 | 522 | 32,100 | .637 | .734 |
| April | 824 | 560 | 630 | 37,490 | .768 | .857 |
| May | 2,885 | 824 | 1,273 | 78,270 | 1.55 | 1.79 |
| June | 4,990 | 3,212 | 4,175 | 248,400 | 5.09 | 5.68 |
| July | 3,420 | 1,412 | 2,352 | 144,600 | 2.87 | 3.31 |
| August | 1,370 | 824 | 1,014 | 62,350 | 1.24 | 1.43 |
| September | 788 | 530 | 619 | 36,830 | .755 | .842 |
| October | 530 | 422 | 475 | 29,210 | .579 | .668 |
| November | 422 | 374 | 377 | 22,430 | .460 | .513 |
| December | 374 | 374 | 374 | 23,000 | .456 | .526 |
| The year | 4,990 | 374 | 1,063 | 769,500 | 1.30 | 17.60 |

## SOUTH FORK OF SNAKE RIVER NEAR LYON, IDAHO.

This station was established April 18, 1903, by N. S. Dils. It is located at the old site of Wedekind's ferry, between Lyon and Swan Valley at the upper end of Conant Valley. It is about 45 miles from Idaho Falls, Idaho.

The channel is straight above and below the station and the current is swift. The right bank is high and steep and will not overflow. At very high stages the left bank will overflow for a considerable distance and some water will pass around the station through a slough. The bed of the stream is composed of hard gravel and is free from vegetation and permanent.

Discharge measurements are made from a cable and car at the old site of Wedekind's ferry. A tagged wire has been installed at the cable. The initial point for soundings is the pin in the top of a log of the crib cable support on the left bank.

The gage is an inclined staff, located on the north bank one-fourth mile below Carr's ferry and 1 mile above the cable. During 1905 the gage was read once each day by O. J. Carr. Bench marks were established as follows: (1) A United States Geological Survey iron bench-mark post set about 6 feet from the gage; elevation, 11.15 feet. (2) A United States Geological Survey aluminum tablet set in a rock on the left bank about 100 feet above Carr's ferry landing and about 6 feet above high-water mark; elevation, 10.44 feet. This bench mark is for use in high water when ferry service is discontinued. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 449–450; 135, p 182.
Discharge: 100, p 450; 135, p 183.
Discharge, monthly: 100, p 452; 135, p 184.
Gage heights: 100, pp 450–451; 135, p 183.
Rating table: 100, p 451; 135, p 184.

*Discharge measurements of South Fork of Snake River near Lyon, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 15 | E. C. La Rue | 260 | 1,500 | 2.37 | 1.85 | 3,556 |
| May 14 | do | 265 | 1,642 | 3.09 | 2.60 | 5,074 |
| June 25 | do | 283 | 2,063 | 5.73 | 4.85 | 11,810 |
| June 26 | do | 283 | 2,083 | 5.88 | 4.90 | 12,220 |
| July 14 | do | 260 | 1,729 | 4.53 | 3.70 | 7,845 |
| September 9 | do | 258 | 1,341 | 2.23 | 1.50 | 2,980 |
| November 15 | do | 251 | 1,275 | 1.76 | .93 | 2,236 |

*Daily gage height, in feet, of South Fork of Snake River near Lyon, Idaho, for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.3 | 2.85 | 5.0 | 4.75 | 2.5 | 1.7 | 1.5 | 1.15 | 0.85 |
| 2 | | 1.3 | 2.9 | 5.3 | 4.7 | 2.45 | 1.65 | 1.45 | 1.15 | .8 |
| 3 | | 1.3 | 3.1 | 5.5 | 4.5 | 2.35 | 1.6 | 1.4 | 1.15 | .9 |
| 4 | | 1.3 | 3.05 | 5.8 | 4.45 | 2.35 | 1.65 | 1.35 | 1.15 | .9 |
| 5 | | 1.3 | 2.8 | 5.9 | 4.4 | 2.3 | 1.6 | 1.35 | 1.15 | .9 |
| 6 | | 1.35 | 2.7 | 5.7 | 4.3 | 2.3 | 1.6 | 1.3 | 1.15 | .7 |
| 7 | | 1.5 | 2.7 | 5.35 | 4.25 | 2.25 | 1.55 | 1.3 | 1.1 | .7 |
| 8 | | 1.8 | 2.8 | 5.7 | 4.2 | 2.2 | 1.55 | 1.3 | 1.1 | .85 |
| 9 | | 1.9 | 3.0 | 6.1 | 4.15 | 2.1 | 1.5 | 1.3 | 1.1 | .8 |
| 10 | | 2.0 | 2.85 | 6.0 | 4.05 | 2.1 | 1.5 | 1.3 | 1.05 | .6 |
| 11 | | 1.8 | 2.7 | 5.6 | 4.0 | 2.05 | 1.5 | 1.3 | .95 | .6 |
| 12 | | 1.7 | 2.7 | 5.4 | 3.9 | 2.05 | 1.45 | 1.3 | .95 | .6 |
| 13 | | 1.75 | 2.6 | 5.55 | 3.85 | 2.05 | 1.45 | 1.3 | 1.0 | .5 |
| 14 | | 1.9 | 2.6 | 5.85 | 3.75 | 2.05 | 1.4 | 1.25 | 1.05 | ........ |
| 15 | 1.35 | 1.8 | 2.65 | 5.95 | 3.7 | 2.0 | 1.4 | 1.25 | 1.0 | ........ |
| 16 | 1.35 | 1.9 | 2.75 | 5.9 | 3.65 | 1.9 | 1.35 | 1.25 | 1.05 | ........ |
| 17 | 1.4 | 1.9 | 3.05 | 5.65 | 3.5 | 1.85 | 1.35 | 1.25 | .95 | ........ |
| 18 | 1.45 | 1.85 | 3.55 | 5.5 | 3.35 | 1.8 | 1.35 | 1.3 | .95 | ........ |
| 19 | 1.45 | 1.9 | 3.7 | 5.1 | 3.25 | 1.8 | 1.3 | 1.25 | .95 | ........ |
| 20 | 1.45 | 2.1 | 3.7 | 4.85 | 3.2 | 1.75 | 1.3 | 1.2 | .9 | ........ |
| 21 | 1.45 | 2.15 | 3.9 | 4.7 | 3.15 | 1.7 | 1.3 | 1.2 | .9 | ........ |

*Daily gage height, in feet, of South Fork of Snake River near Lyon, Idaho, for 1905*—Continued.

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 1.4 | 2.2 | 3.85 | 4.7 | 3.1 | 1.7 | 1.3 | 1.2 | 0.95 | ........ |
| 23 | 1.35 | 2.25 | 3.8 | 4.9 | 2.95 | 1.75 | 1.25 | 1.2 | .95 | ........ |
| 24 | 1.35 | 2.4 | 3.75 | 4.85 | 2.9 | 1.75 | 1.3 | 1.2 | .95 | ........ |
| 25 | 1.3 | 2.5 | 3.75 | 4.85 | 2.85 | 1.75 | 1.35 | 1.2 | .95 | ........ |
| 26 | 1.3 | 2.7 | 3.95 | 4.9 | 2.8 | 1.8 | 1.3 | 1.2 | .95 | ........ |
| 27 | 1.45 | 2.8 | 4.2 | 5.1 | 2.75 | 1.75 | 1.3 | 1.25 | .95 | ........ |
| 28 | 1.4 | 2.65 | 4.6 | 5.15 | 2.65 | 1.75 | 1.3 | 1.25 | .95 | ........ |
| 29 | 1.35 | 2.5 | 4.65 | 5.05 | 2.6 | 1.75 | 1.35 | 1.2 | .9 | ........ |
| 30 | 1.35 | 2.5 | 4.6 | 4.85 | 2.5 | 1.75 | 1.5 | 1.2 | .85 | ........ |
| 31 | 1.35 | ........ | 4.7 | ........ | 2.5 | 1.75 | ........ | 1.15 | ........ | ........ |

NOTE.—River gorged with ice December 14–31.

*Station rating table for South Fork of Snake River near Lyon, Idaho, from March 15 to December 13, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.50 | 1,800 | 1.70 | 3,320 | 2.90 | 5,750 | 4.00 | 8,760 |
| 0.60 | 1,900 | 1.80 | 3,495 | 3.00 | 5,980 | 4.20 | 9,420 |
| 0.70 | 2,005 | 1.90 | 3,680 | 3.10 | 6,220 | 4.40 | 10,150 |
| 0.80 | 2,115 | 2.00 | 3,870 | 3.20 | 6,470 | 4.60 | 10,920 |
| 0.90 | 2,225 | 2.10 | 4,065 | 3.30 | 6,730 | 4.80 | 11,710 |
| 1.00 | 2,340 | 2.20 | 4,265 | 3.40 | 7,000 | 5.00 | 12,520 |
| 1.10 | 2,460 | 2.30 | 4,465 | 3.50 | 7,280 | 5.20 | 13,370 |
| 1.20 | 2,585 | 2.40 | 4,670 | 3.60 | 7,560 | 5.40 | 14,290 |
| 1.30 | 2,715 | 2.50 | 4,880 | 3.70 | 7,850 | 5.60 | 15,270 |
| 1.40 | 2,855 | 2.60 | 5,090 | 3.80 | 8,150 | 5.80 | 16,280 |
| 1.50 | 3,000 | 2.70 | 5,310 | 3.90 | 8,450 | 6.00 | 17,320 |
| 1.60 | 3,155 | 2.80 | 5,530 | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1905. It is well defined.

*Estimated monthly discharge of South Fork Snake River near Lyon, Idaho, for 1905.*

[Drainage area, 5,480 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 15–31 | 2,928 | 2,715 | 2,831 | 95,460 | 0.517 | 0.327 |
| April | 5,530 | 2,715 | 3,821 | 227,400 | .697 | .778 |
| May | 11,310 | 5,090 | 7,124 | 438,000 | 1.30 | 1.50 |
| June | 17,850 | 11,310 | 14,220 | 846,200 | 2.59 | 2.89 |
| July | 11,510 | 4,880 | 7,675 | 471,900 | 1.40 | 1.61 |
| August | 4,880 | 3,320 | 3,848 | 236,600 | .702 | .809 |
| September | 3,320 | 2,650 | 2,900 | 172,600 | .529 | .590 |
| October | 3,000 | 2,522 | 2,681 | 164,800 | .489 | .564 |
| November | 2,522 | 2,170 | 2,354 | 140,100 | .430 | .480 |
| December 1–13 | 2,225 | 1,800 | 2,058 | 53,070 | .376 | .182 |
| The period | .......... | .......... | .......... | 2,846,000 | .......... | .......... |

## BLACKFOOT RIVER NEAR PRESTO, IDAHO.

This station was established April 17, 1903, by N. S. Dils. It is located on the ranch of James Just, 2 miles west of Presto and about 15 miles from Blackfoot, Idaho.

The current is sluggish. The banks are high and wooded and will not overflow. The bed of the stream is composed of gravel and is free from vegetation and permanent.

Discharge measurements are made from a cable and car located about one-fourth mile below the gage. The initial point for soundings is a tag marked "I. P." fastened to the inner face of the cable support on the west bank.

The gage is an inclined staff. During 1905 the gage was read once each day by James Just. The bench mark is a copper plug set in the corner stone of Mr. Just's brick house; elevation, 12.18 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description**: 100, p 447; 135, p 186.
**Discharge**: 100, p 447; 135, p 186.
**Gage heights**: 100, p 448; 135, p 187.

*Discharge measurements of Blackfoot River near Presto, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 16 | E. C. La Rue | 54 | 197 | 2.23 | 2.20 | 439 |
| May 19 | do | 55 | 170 | 1.63 | 1.50 | 277 |
| June 8 | do | 52 | 145 | 1.41 | 1.00 | 205 |
| July 9 | do | 53 | 105 | .90 | .30 | 95 |

*Daily gage height, in feet, of Blackfoot River near Presto, Idaho, for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.4 | 2.1 | 1.2 | 0.5 | 0.1 | 0.25 | 0.55 | 0.7 | 0.5 |
| 2 | | 1.4 | 2.1 | 1.2 | .5 | .1 | .25 | .6 | .7 | .4 |
| 3 | | 1.45 | 2.35 | 1.15 | .4 | .1 | .2 | .6 | .65 | .6 |
| 4 | | 1.6 | 2.5 | 1.15 | .4 | .05 | .2 | .5 | .65 | .8 |
| 5 | 0.9 | 1.6 | 2.85 | 1.1 | .4 | .05 | .2 | .5 | .6 | .8 |
| 6 | .9 | 1.7 | 2.9 | 1.1 | .35 | .05 | .2 | .55 | .7 | .9 |
| 7 | 1.0 | 1.85 | 2.8 | 1.0 | .35 | .1 | .2 | .6 | .7 | .7 |
| 8 | 1.0 | 2.1 | 2.55 | 1.0 | .3 | .1 | .2 | .6 | .7 | .7 |
| 9 | 1.0 | 2.25 | 2.25 | 1.0 | .3 | .1 | .2 | .5 | .7 | .8 |
| 10 | .9 | 2.2 | 2.1 | .9 | .3 | .1 | .2 | .6 | .6 | .8 |
| 11 | .8 | 2.2 | 2.15 | .9 | .3 | .15 | .2 | .6 | .6 | .75 |
| 12 | 1.0 | 2.1 | 2.1 | .9 | .3 | .15 | .2 | .6 | .5 | .8 |
| 13 | .9 | 2.0 | 2.05 | 1.0 | .25 | .15 | .2 | .6 | .5 | .8 |
| 14 | 1.05 | 2.1 | 2.0 | 1.0 | .25 | .15 | .2 | .6 | .6 | .9 |
| 15 | 1.2 | 2.1 | 1.9 | 1.0 | .25 | .15 | .2 | .55 | .6 | .95 |
| 16 | 1.3 | 2.15 | 1.7 | 1.0 | .25 | .15 | .2 | .6 | .65 | 1.0 |
| 17 | 1.3 | 2.25 | 1.65 | .9 | .2 | .2 | .2 | .6 | .7 | 1.0 |
| 18 | 1.45 | 2.2 | 1.45 | .8 | .2 | .2 | .2 | .6 | .7 | 1.0 |
| 19 | 1.7 | 2.3 | 1.5 | .8 | .2 | .2 | .25 | .65 | .7 | .8 |
| 20 | 1.6 | 2.3 | 1.5 | .8 | .2 | .2 | .25 | .65 | .7 | .7 |
| 21 | 1.6 | 2.4 | 1.5 | .8 | .3 | .2 | .25 | .65 | .6 | .9 |
| 22 | 1.65 | 2.5 | 1.5 | .8 | .3 | .2 | .25 | .65 | .7 | .9 |
| 23 | 1.5 | 2.5 | 1.5 | .8 | .2 | .25 | .3 | .7 | .75 | 1.0 |
| 24 | 1.5 | 2.4 | 1.45 | .8 | .2 | 2.65 | .3 | .7 | .75 | 1.05 |

### *Daily gage height, in feet, of Blackfoot River near Presto, Idaho, for 1905*—Continued.

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 1.4 | 2.4 | 1.45 | 0.7 | 0.2 | 1.3 | 0.3 | 0.7 | 0.8 | 1.0 |
| 26 | 1.55 | 2.4 | 1.4 | .7 | .2 | .5 | .35 | .7 | .8 | 1.0 |
| 27 | 1.7 | 2.4 | 1.4 | .65 | .2 | .4 | .35 | .7 | .7 | 1.1 |
| 28 | 1.7 | 2.4 | 1.3 | .65 | .2 | .3 | .4 | .7 | .7 | 1.0 |
| 29 | 1.7 | 2.4 | 1.3 | .65 | .2 | .3 | .5 | .7 | .6 | 1.0 |
| 30 | 1.75 | 2.25 | 1.3 | .65 | .15 | .3 | .5 | .7 | .6 | 1.0 |
| 31 | 1.6 | ........ | 1.25 | ........ | .15 | .25 | ........ | .7 | ........ | 1.1 |

NOTE.—No ice record.

### *Station rating table for Blackfoot River near Presto, Idaho, from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.00 | 59 | 1.40 | 269 | 2.80 | 577 | 4.40 | 1,155 |
| .10 | 70 | 1.50 | 287 | 2.90 | 606 | 4.60 | 1,240 |
| .20 | 82 | 1.60 | 306 | 3.00 | 636 | 4.80 | 1,340 |
| .30 | 94 | 1.70 | 325 | 3.10 | 668 | 5.00 | 1,440 |
| .40 | 107 | 1.80 | 345 | 3.20 | 701 | 5.20 | 1,540 |
| .50 | 121 | 1.90 | 365 | 3.30 | 735 | 5.40 | 1,640 |
| .60 | 135 | 2.00 | 386 | 3.40 | 770 | 5.60 | 1,760 |
| .70 | 150 | 2.10 | 407 | 3.50 | 805 | 5.80 | 1,880 |
| .80 | 166 | 2.20 | 429 | 3.60 | 840 | 6.00 | 2,000 |
| .90 | 182 | 2.30 | 451 | 3.70 | 875 | 6.20 | 2,120 |
| 1.00 | 199 | 2.40 | 474 | 3.80 | 915 | 6.40 | 2,240 |
| 1.10 | 216 | 2.50 | 498 | 3.90 | 955 | 6.60 | 2,380 |
| 1.20 | 233 | 2.60 | 523 | 4.00 | 995 | 6.80 | 2,520 |
| 1.30 | 251 | 2.70 | 549 | 4.20 | 1,075 | 7.00 | 2,660 |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined between gage heights 0.3 foot and 2.7 feet.

### *Estimated monthly discharge of Blackfoot River near Presto, Idaho, for 1904 and 1905.*

[Drainage area, 1,016 square miles.]

| Month | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| 1904. | | | | | | |
| June | 975 | 233 | 536 | 31,890 | 0.528 | 0.589 |
| July | 216 | 150 | 179 | 11,010 | .176 | .203 |
| August | 182 | 150 | 161 | 9,900 | .158 | .182 |
| September | 216 | 182 | 198 | 11,780 | .195 | .218 |
| October | 269 | 216 | 251 | 15,430 | .247 | .285 |
| November | 269 | 216 | 230 | 13,680 | .226 | .252 |
| December 1-10 | 269 | 216 | 238 | 4,721 | .234 | .087 |
| The period | ........ | ........ | ........ | 98,410 | ........ | ........ |

*Estimated monthly discharge of Blackfoot River near Presto, Idaho, for 1904 and 1905*—Continued.

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| 1905. | | | | | | |
| March 5-31 | 335 | 166 | 256 | 13,710 | 0.252 | 0.253 |
| April | 498 | 269 | 412 | 24,520 | .406 | .453 |
| May | 606 | 242 | 368 | 22,630 | .362 | .417 |
| June | 233 | 142 | 183 | 10,890 | .180 | .201 |
| July | 121 | 76 | 91.2 | 5,608 | .090 | .104 |
| August | 536 | 64 | 100 | 6,149 | .098 | .113 |
| September | 121 | 82 | 89.0 | 5,296 | .088 | .098 |
| October | 150 | 121 | 138 | 8,485 | .136 | .157 |
| November | 166 | 121 | 145 | 8,628 | .143 | .160 |
| December | 216 | 107 | 177 | 10,880 | .174 | .201 |
| The period | | | | 116,800 | | |

**Note.**—No estimate for ice period.

## BIG LOST RIVER NEAR MACKAY, IDAHO.

This station was established November 12, 1903, by Fred Stockton. It is located 3½ miles above Mackay, Idaho, above "The Narrows."

The channel of the stream is slightly curved both above and below the station. The south bank is steep and high and does not overflow; the north bank slopes gradually and will overflow during high water.

Discharge measurements are made from a cable. The initial point for soundings is a tin tag marked "I. P." on the inside face of cable support on north bank of stream.

A permanent gage was set November 3, 1904, at "The Narrows," about a mile below the cable. It is located back of Joseph Cresto's house and consists of a post set vertically and securely anchored. During 1905 the gage was read once each day by Joseph Cresto. The bench mark is a United States Geological Survey iron bench-mark post set about 15 feet from the gage; elevation, 9.83 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 447; 135, pp 187–188.
Discharge: 135, p 188.
Discharge, monthly: 135, p 189.
Gage heights: 100, p 447; 135, p 188.
Rating table: 135, p 189.

*Discharge measurements of Big Lost River near Mackay, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | E. C. La Rue | 37 | 74 | 1.84 | 2.50 | 136 |
| May 15 | do | 37 | 72 | 1.72 | 2.45 | 124 |
| June 10 | do | 51 | 193 | 5.12 | 5.15 | 987 |
| July 11 | do | 44 | 151 | 4.17 | 4.10 | 629 |
| September 21 | do | 37 | 89 | 1.75 | 2.65 | 156 |
| November 22 | do | 38 | 93 | 1.89 | 2.80 | 176 |

*Daily gage height, in feet, of Big Lost River near Mackay, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.7 | 2.65 | 2.6 | 2.6 | 2.5 | 3.9 | 4.5 | 3.15 | 2.75 | 2.7 | 2.8 | 2.8 |
| 2 | 2.7 | 2.65 | 2.6 | 2.6 | 2.5 | 4.3 | 4.6 | 3.1 | 2.75 | 2.7 | 2.8 | 2.8 |
| 3 | 2.7 | 2.65 | 2.6 | 2.6 | 2.5 | 4.5 | 4.4 | 3.1 | 2.75 | 2.7 | 2.8 | 2.8 |
| 4 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.5 | 4.35 | 3.1 | 2.75 | 2.7 | 2.8 | 2.8 |
| 5 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.8 | 4.3 | 3.05 | 2.7 | 2.7 | 2.8 | 2.75 |
| 6 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.85 | 4.3 | 3.05 | 2.7 | 2.7 | 2.8 | 2.75 |
| 7 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.6 | 4.3 | 3.05 | 2.7 | 2.7 | 2.8 | 2.75 |
| 8 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.5 | 4.3 | 3.05 | 2.7 | 2.75 | 2.8 | 2.75 |
| 9 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 5.0 | 4.25 | 3.05 | 2.7 | 2.75 | 2.8 | 2.75 |
| 10 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 5.15 | 4.25 | 3.0 | 2.7 | 2.75 | 2.8 | 2.75 |
| 11 | 2.7 | 2.65 | 2.6 | 2.55 | 2.5 | 4.8 | 4.1 | 3.0 | 2.7 | 2.75 | 2.8 | 2.75 |
| 12 | 2.7 | 2.65 | 2.6 | 2.5 | 2.5 | 5.2 | 4.05 | 3.0 | 2.7 | 2.75 | 2.8 | 2.75 |
| 13 | 2.7 | 2.65 | 2.6 | 2.5 | 2.5 | 5.35 | 4.0 | 2.95 | 2.7 | 2.75 | 2.8 | 2.75 |
| 14 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 5.4 | 3.85 | 2.95 | 2.7 | 2.75 | 2.8 | 2.75 |
| 15 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 5.2 | 3.7 | 2.9 | 2.7 | 2.75 | 2.8 | 2.75 |
| 16 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 4.95 | 3.7 | 2.9 | 2.7 | 2.75 | 2.8 | 2.75 |
| 17 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 4.95 | 3.6 | 2.9 | 2.7 | 2.75 | 2.8 | 2.75 |
| 18 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 4.9 | 3.55 | 2.9 | 2.7 | 2.75 | 2.8 | 2.75 |
| 19 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 4.5 | 3.5 | 2.9 | 2.65 | 2.8 | 2.8 | 2.75 |
| 20 | 2.7 | 2.65 | 2.6 | 2.5 | 2.45 | 4.5 | 3.45 | 2.9 | 2.65 | 2.8 | 2.8 | 2.75 |
| 21 | 2.7 | 2.6 | 2.6 | 2.5 | 2.45 | 4.5 | 3.4 | 2.9 | 2.65 | 2.8 | 2.8 | 2.75 |
| 22 | 2.7 | 2.6 | 2.6 | 2.5 | 2.5 | 4.8 | 3.4 | 2.85 | 2.65 | 2.8 | 2.8 | 2.75 |
| 23 | 2.7 | 2.6 | 2.6 | 2.5 | 2.55 | 5.0 | 3.45 | 2.85 | 2.65 | 2.8 | 2.8 | 2.75 |
| 24 | 2.7 | 2.6 | 2.6 | 2.5 | 2.55 | 4.9 | 3.4 | 2.85 | 2.65 | 2.8 | 2.8 | 2.75 |
| 25 | 2.65 | 2.6 | 2.6 | 2.5 | 2.55 | 4.75 | 3.4 | 2.8 | 2.65 | 2.8 | 2.8 | 2.7 |
| 26 | 2.65 | 2.6 | 2.6 | 2.5 | 2.55 | 4.6 | 3.35 | 2.8 | 2.65 | 2.8 | 2.8 | 2.7 |
| 27 | 2.65 | 2.6 | 2.6 | 2.5 | 2.55 | 4.6 | 3.3 | 2.8 | 2.65 | 2.8 | 2.8 | 2.7 |
| 28 | 2.65 | 2.6 | 2.6 | 2.5 | 2.65 | 4.5 | 3.3 | 2.8 | 2.65 | 2.8 | 2.8 | 2.7 |
| 29 | 2.65 | ....... | 2.6 | 2.5 | 2.9 | 4.4 | 3.3 | 2.8 | 2.65 | 2.8 | 2.8 | 2.7 |
| 30 | 2.65 | ....... | 2.6 | 2.5 | 3.1 | 4.4 | 3.25 | 2.75 | 2.65 | 2.8 | 2.8 | 2.7 |
| 31 | 2.65 | ....... | 2.6 | ....... | 3.3 | ....... | 3.2 | 2.75 | ....... | 2.8 | ....... | 2.7 |

NOTE.—No ice record.

*Station rating table for Big Lost River near Mackay, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.50 | 129 | 3.30 | 313 | 4.10 | 592 | 4.80 | 868 |
| 2.60 | 145 | 3.40 | 345 | 4.20 | 630 | 4.90 | 909 |
| 2.70 | 163 | 3.50 | 378 | 4.30 | 669 | 5.00 | 950 |
| 2.80 | 183 | 3.60 | 412 | 4.40 | 708 | 5.10 | 992 |
| 2.90 | 205 | 3.70 | 447 | 4.50 | 748 | 5.20 | 1,034 |
| 3.00 | 229 | 3.80 | 482 | 4.60 | 788 | 5.30 | 1,077 |
| 3.10 | 255 | 3.90 | 518 | 4.70 | 828 | 5.40 | 1,120 |
| 3.20 | 283 | 4.00 | 555 | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is well defined.

*Estimated monthly discharge of Big Lost River near Mackay, Idaho, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 163 | 154 | 161 | 9,900 |
| February | 154 | 145 | 151 | 8,386 |
| March | 145 | 145 | 145 | 8,916 |
| April | 145 | 129 | 133 | 7,914 |
| May | 313 | 122 | 142 | 8,731 |
| June | 1,120 | 518 | 847 | 50,400 |
| July | 788 | 283 | 489 | 30,070 |
| August | 269 | 173 | 214 | 13,160 |
| September | 173 | 154 | 161 | 9,580 |
| October | 183 | 163 | 175 | 10,760 |
| November | 183 | 183 | 183 | 10,890 |
| December | 183 | 163 | 172 | 10,580 |
| The year | 1,120 | 122 | 248 | 179,300 |

## BIG LOST RIVER NEAR CHILLY, IDAHO.

This station was established April 25, 1904, by Fred Stockton. It is located at Frank Uehren's ranch, about 25 miles upstream from Mackay, 7 miles from Chilly, and about 3 miles above Kinickinick Point. This ranch is the last one on the east bank.

The channel is straight for about 200 feet above and 250 feet below the station. Both banks are low and liable to overflow during high water. The stream has but one channel during all stages.

Discharge measurements are made from a cable and car located about three-fourths of a mile above Mr. Uehren's house. The initial point for soundings is a tin tag marked "I. P." on the face of the cable support on east side.

The gage is a vertical staff located about one-fourth mile from the ranch house. During 1905 the gage was read once each day by Frank Uehren and J. S. Fullmer. The bench mark is a United States Geological Survey iron bench-mark post about 10 feet from the gage; elevation, 7.49 feet above the datum of the gage.

A description of this station, with gage heights, discharge data, and rating table is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 190-192.

*Discharge measurements of Big Lost River near Chilly, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 18 | E. C. La Rue | 81 | 109 | 1.01 | 1.57 | 110 |
| May 16 | do | 82 | 142 | 1.53 | 2.10 | 217 |
| June 11 | do | 84 | 247 | 4.08 | 4.25 | 1,007 |
| July 12 | do | 83 | 221 | 3.04 | 3.50 | 671 |
| September 22 | do | 82 | 103 | .85 | 1.45 | 88 |
| November 21 | do | 81 | 101 | .87 | 1.45 | 88 |

*Daily gage height, in feet, of Big Lost River near Chilly, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.3 | 1.4 | 1.3 | 1.4 | 1.9 | 4.55 | 3.65 | 2.3 | 1.9 | 1.7 | 1.5 | 1.5 |
| 2 | 1.3 | 1.4 | 1.3 | 1.5 | 1.9 | 4.7 | 3.65 | 2.4 | 1.85 | 1.7 | 1.5 | 1.5 |
| 3 | 1.4 | 1.4 | 1.3 | 1.5 | 1.9 | 4.5 | 3.65 | 2.4 | 1.8 | 1.7 | 1.5 | 1.7 |
| 4 | 1.35 | 1.45 | 1.4 | 1.4 | 1.8 | 4.1 | 3.9 | 2.3 | 1.8 | 1.65 | 1.5 | 1.5 |
| 5 | 1.3 | 1.4 | 1.4 | 1.5 | 1.8 | 4.5 | 3.7 | 2.4 | 1.8 | 1.65 | 1.5 | 1.5 |
| 6 | 1.3 | 1.4 | 1.4 | 1.6 | 1.8 | 3.95 | 3.55 | 2.3 | 1.8 | 1.65 | 1.5 | 1.4 |
| 7 | 1.4 | 1.4 | 1.4 | 1.6 | 1.8 | 4.0 | 3.8 | 2.3 | 1.75 | 1.65 | 1.5 | 1.4 |
| 8 | 1.3 | 1.4 | 1.4 | 1.6 | 2.0 | 4.5 | 3.5 | 2.3 | 1.75 | 1.65 | 1.5 | 1.35 |
| 9 | 1.3 | 1.35 | 1.4 | 1.6 | 2.0 | 4.6 | 3.45 | 2.2 | 1.75 | 1.65 | 1.5 | 1.3 |
| 10 | 1.35 | 1.5 | 1.4 | 1.6 | 2.0 | 4.1 | 3.55 | 2.2 | 1.75 | 1.7 | 1.5 | 1.3 |
| 11 | 1.5 | 1.65 | 1.4 | 1.5 | 1.9 | 4.2 | 3.55 | 2.15 | 1.7 | 1.7 | 1.6 | 1.3 |
| 12 | 1.5 | 1.8 | 1.5 | 1.6 | 1.9 | 4.9 | 3.5 | 2.15 | 1.7 | 1.65 | 1.65 | 1.3 |
| 13 | 1.5 | 1.6 | 1.5 | 1.6 | 1.9 | 4.9 | 3.4 | 2.05 | 1.7 | 1.65 | 1.65 | 1.3 |
| 14 | 1.5 | 1.6 | 1.5 | 1.6 | 1.9 | 4.9 | 3.1 | 2.05 | 1.7 | 1.65 | 1.7 | 1.3 |
| 15 | 1.4 | 1.5 | 1.5 | 1.6 | 1.9 | 4.75 | 3.1 | 2.0 | 1.7 | 1.65 | 1.8 | 1.35 |
| 16 | 1.4 | 1.5 | 1.5 | 1.7 | 2.0 | 4.1 | 3.0 | 2.0 | 1.7 | 1.65 | 2.0 | 1.35 |
| 17 | 1.4 | 1.5 | 1.5 | 1.7 | 2.65 | 3.9 | 3.0 | 2.0 | 1.7 | 1.6 | 1.9 | 1.3 |
| 18 | 1.4 | 1.6 | 1.5 | 1.7 | 2.95 | 3.8 | 2.7 | 1.9 | 1.7 | 1.6 | 1.9 | 1.35 |
| 19 | ...... | 1.7 | 1.4 | 1.7 | 2.95 | 3.45 | 2.75 | 1.9 | 1.7 | 1.6 | 1.9 | 1.35 |
| 20 | ...... | 1.5 | 1.4 | 1.7 | 3.1 | 3.5 | 2.8 | 1.9 | 1.7 | 1.6 | 1.9 | 1.4 |
| 21 | 1.5 | 1.5 | 1.4 | 1.7 | 3.05 | 3.95 | 2.7 | 1.9 | 1.65 | 1.6 | 1.45 | 1.35 |
| 22 | 1.4 | 1.4 | 1.4 | 1.7 | 2.75 | 4.15 | 2.75 | 1.9 | 1.65 | 1.6 | 1.45 | 1.35 |
| 23 | 1.4 | 1.4 | 1.4 | 1.7 | 2.65 | 4.2 | 2.7 | 1.9 | 1.65 | 1.6 | 1.45 | 1.3 |
| 24 | 1.4 | 1.4 | 1.4 | 1.8 | 2.5 | 3.95 | 2.6 | 1.85 | 1.7 | 1.5 | 1.45 | 1.3 |
| 25 | 1.4 | 1.5 | 1.4 | 1.8 | 2.7 | 3.7 | 2.4 | 1.9 | 1.7 | 1.5 | 1.5 | 1.35 |
| 26 | 1.4 | 1.3 | 1.4 | 1.9 | 2.85 | 3.9 | 2.5 | 1.9 | 1.65 | 1.5 | 1.5 | 1.35 |
| 27 | 1.4 | 1.3 | 1.4 | 1.9 | 3.15 | 3.9 | 2.55 | 1.9 | 1.65 | 1.5 | 1.5 | 1.35 |
| 28 | 1.4 | 1.3 | 1.4 | 1.9 | 3.45 | 3.6 | 2.5 | 1.9 | 1.65 | 1.5 | 1.5 | 1.35 |
| 29 | 1.4 | ...... | 1.5 | 1.9 | 3.25 | 3.7 | 2.3 | 1.85 | 1.65 | 1.5 | 1.5 | 1.35 |
| 30 | 1.4 | ...... | 1.5 | 1.9 | 3.4 | 3.7 | 2.3 | 1.8 | 1.7 | 1.5 | 1.5 | 1.4 |
| 31 | 1.35 | ...... | 1.4 | ...... | 3.7 | ...... | 2.3 | 1.85 | ...... | 1.5 | ...... | 1.35 |

NOTE.—No ice record.

*Station rating table for Big Lost River near Chilly, Idaho, from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 65 | 2.30 | 267 | 3.20 | 553 | 4.10 | 937 |
| 1.40 | 80 | 2.40 | 293 | 3.30 | 591 | 4.20 | 985 |
| 1.50 | 96 | 2.50 | 320 | 3.40 | 630 | 4.30 | 1,034 |
| 1.60 | 114 | 2.60 | 349 | 3.50 | 670 | 4.40 | 1,084 |
| 1.70 | 133 | 2.70 | 379 | 3.60 | 712 | 4.50 | 1,135 |
| 1.80 | 153 | 2.80 | 411 | 3.70 | 755 | 4.60 | 1,188 |
| 1.90 | 174 | 2.90 | 445 | 3.80 | 799 | 4.70 | 1,242 |
| 2.00 | 195 | 3.00 | 480 | 3.90 | 844 | 4.80 | 1,298 |
| 2.10 | 218 | 3.10 | 516 | 4.00 | 890 | 4.90 | 1,355 |
| 2.20 | 242 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905 and one during 1904. It is well defined.

*Estimated monthly discharge of Big Lost River near Chilly, Idaho, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 96 | 65 | 79.4 | 4,882 |
| February | 153 | 65 | 92.1 | 5,115 |
| March | 96 | 65 | 86.3 | 5,306 |
| April | 174 | 80 | 127 | 7,557 |
| May | 755 | 153 | 326 | 20,040 |
| June | 1,355 | 650 | 973 | 57,900 |
| July | 844 | 267 | 517 | 31,790 |
| August | 293 | 153 | 211 | 12,970 |
| September | 174 | 124 | 137 | 8,152 |
| October | 133 | 96 | 116 | 7,133 |
| November | 195 | 88 | 114 | 6,783 |
| December | 133 | 65 | 75.6 | 4,648 |
| The year | 1,355 | 65 | 238 | 172,300 |

NOTE.—Missing gage heights interpolated.

## BIG WOOD RIVER NEAR GIMLET, IDAHO.

This station was established by Fred Stockton April 25, 1904, and was discontinued May 31, 1905. The station is located on a wagon bridge on the road from Hailey to Ketchum, near Gimlet, a small station on the Oregon Short Line Railroad, about 6 miles from Hailey and 6 miles from Ketchum. The wagon bridge is about 200 feet below the railroad bridge crossing Big Wood River.

The channel is straight for 250 feet above and 1,000 feet below the bridge. The banks are high and covered with brush and are not liable to overflow. The stream has but one channel in either high or low water.

Discharge measurements are made from the bridge. The initial point for soundings is a tag marked "I. P." nailed on the hand rail on the downstream side of the bridge.

The gage is a staff, spiked against a timber on the upstream side of the north abutment to the wagon bridge. During 1905 the gage was read once each day by A. C. Comstock. The bench mark is a United States Geological Survey iron bench-mark post set in the dooryard of the first ranch house above Gimlet; elevation, 5,544 feet above sea level and 15.09 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 192–193.

*Discharge measurements of Big Wood River near Gimlet, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 22 | E. C. LaRue | 40 | 165 | 1.92 | 1.05 | 317 |
| May 22 | do | 40 | 178 | 2.84 | 1.60 | 505 |

*Daily gage height, in feet, of Big Wood River near Gimlet, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Day. | Jan. | Feb. | Mar. | Apr. | May. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.6 | 0.6 | 0.55 | 0.6 | 1.05 | 17 | 0.6 | 0.6 | 0.7 | 0.9 | 1.35 |
| 2 | .6 | .6 | .55 | .65 | 1.05 | 18 | .6 | .6 | .7 | .9 | 1.5 |
| 3 | .6 | .6 | .5 | .7 | 1.0 | 19 | .6 | .6 | .7 | .9 | 1.7 |
| 4 | .6 | .6 | .55 | .7 | 1.0 | 20 | .6 | .6 | .7 | .95 | 1.8 |
| 5 | .6 | .6 | .55 | .8 | 1.0 | 21 | .6 | .6 | .7 | .95 | 1.7 |
| 6 | .6 | .6 | .6 | .95 | 1.0 | 22 | .6 | .6 | .7 | 1.0 | 1.6 |
| 7 | .6 | .6 | .6 | .95 | 1.05 | 23 | .6 | .6 | .7 | 1.0 | 1.6 |
| 8 | .6 | .6 | .6 | .95 | 1.1 | 24 | .6 | .6 | .7 | 1.0 | 1.65 |
| 9 | .6 | .6 | .65 | 1.0 | 1.1 | 25 | .6 | .6 | .7 | 1.0 | 1.7 |
| 10 | .6 | .6 | .65 | 1.0 | 1.05 | 26 | .6 | .6 | .7 | 1.1 | 1.8 |
| 11 | .6 | .6 | .65 | 1.0 | 1.05 | 27 | .6 | .6 | .7 | 1.1 | 1.75 |
| 12 | .6 | .6 | .65 | 1.0 | 1.05 | 28 | .6 | .6 | .7 | 1.1 | 1.6 |
| 13 | .6 | .6 | .65 | .95 | 1.05 | 29 | .6 | ....... | .65 | 1.1 | 1.7 |
| 14 | .6 | .6 | .7 | .95 | 1.1 | 30 | .6 | ....... | .6 | 1.1 | 1.7 |
| 15 | .6 | .6 | .7 | .95 | 1.2 | 31 | .6 | ....... | .6 | ....... | 1.75 |
| 16 | .6 | .6 | .7 | .95 | 1.2 | | | | | | |

NOTE.—No ice record.

## BIG WOOD RIVER NEAR SHOSHONE, IDAHO.

This station was established June 5, 1905, by E. C. La Rue. It is located at A. D. Silva's ranch, 1 mile below the steel wagon bridge and 7 miles northwest of Shoshone, Idaho, the nearest railway point. The water is sluggish during low stages, but rather swift during high water. Both banks are high and not liable to overflow. Measurements are made from a boat, held by a cable. The initial point for soundings is a post on the right bank which is used as a support for the tag wire. The gage is a vertical staff on the right bank, 100 yards below the cable. During 1905 the gage was read once each day by A. D. Silva. The bench mark is a standard United States Geological Survey iron post set about 3 feet from the southeast corner of Mr. Silva's house; elevation, 13.12 feet above the datum of the gage.

*Daily gage height, in feet, of Big Wood River near Shoshone, Idaho, for 1905.*

| Day. | June. | July. | Day. | June. | July. | Day. | June. | July. | Day. | June. | July. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.75 | 9 | 3.55 | 2.85 | 17 | 3.7 | 2.5 | 25 | 3.0 | 2.0 |
| 2 | ...... | 2.75 | 10 | 3.75 | 2.8 | 18 | 3.75 | 2.5 | 26 | 2.95 | 1.95 |
| 3 | ...... | 2.75 | 11 | 3.7 | 2.8 | 19 | 3.55 | 2.4 | 27 | 2.9 | 1.9 |
| 4 | ...... | 2.75 | 12 | 3.6 | 2.75 | 20 | 3.3 | 2.35 | 28 | 2.9 | (a) |
| 5 | 3.75 | 2.7 | 13 | 3.75 | 2.7 | 21 | 3.1 | 2.2 | 29 | 2.9 | ...... |
| 6 | 3.9 | 2.7 | 14 | 3.85 | 2.65 | 22 | 2.95 | 2.2 | 30 | 2.85 | ...... |
| 7 | 3.7 | 2.6 | 15 | 3.8 | 2.6 | 23 | 2.95 | 2.15 | | | |
| 8 | 3.5 | 2.5 | 16 | 3.8 | 2.55 | 24 | 3.0 | 2.1 | | | |

[a] River dry remainder of year.

## LITTLE WOOD RIVER NEAR CAREY, IDAHO.

This station was established April 28, 1904, by William G. Davies, and was discontinued May 31, 1905. The station is located 7 miles upstream from Carey on the Carey-Muldoon road, about one-half mile above the dam at the head of the east and west side canals, and above the slough or delta section of the river. It is 15 miles from Picabo, the nearest railroad point.

The channel is straight both above and below the station. The banks are high and clean, and not liable to overflow. The stream has one channel at both high and low water and its bed is smooth and clean.

Discharge measurements are made from a cable and car. The initial point for soundings is a tin tag marked "I. P." on an iron anchor set in a rock on the west bank.

The gage is a vertical staff bolted to a lava wall on the east bank of the river. During 1905 the gage was read once each day by Mrs. F. M. Ford. The bench mark is a United States Geological Survey aluminum bench mark tablet set 3 feet from the gage in solid lava; elevation, 6.00 feet above the datum of the gage.

A description of this station and gage height and discharge data are contained in Water Supply Paper No. 135, United States Geological Survey, pages 193–195.

*Discharge measurements of Little Wood River near Carey, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 23........ | E. C. La Rue ......................... | 39 | 91 | 1.53 | 1.42 | 139 |
| May 23........ | .....do ................................ | 42 | 100 | 1.84 | 1.65 | 184 |

*Daily gage height, in feet, of Little Wood River near Carey, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | Day. | Jan. | Feb. | Mar. | Apr. | May. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1............ | 1.0 | 1.0 | 1.8 | 1.1 | 1.4 | 17............ | 1.8 | 1.3 | 1.1 | 1.1 | 1.3 |
| 2............ | 1.0 | 1.1 | 1.7 | 1.1 | 1.5 | 18............ | 1.6 | 1.4 | 1.0 | 1.1 | 1.4 |
| 3............ | 1.0 | 1.1 | 1.2 | 1.1 | 1.7 | 19............ | 1.6 | 1.4 | 1.1 | 1.2 | 1.6 |
| 4............ | 1.1 | 1.1 | 1.0 | 1.1 | 1.6 | 20............ | 1.6 | 1.6 | 1.1 | 1.2 | 1.6 |
| 5............ | 1.1 | 1.1 | 1.0 | 1.2 | 1.6 | 21............ | 1.0 | 1.6 | 1.1 | 1.1 | 1.7 |
| 6............ | 1.1 | 1.1 | 1.0 | 1.3 | 1.6 | 22............ | 1.0 | 1.6 | 1.1 | 1.4 | 1.7 |
| 7............ | 1.1 | 1.1 | 1.0 | 1.6 | 1.5 | 23............ | 1.0 | 1.6 | 1.1 | 1.4 | 1.7 |
| 8............ | 1.0 | 1.1 | 1.0 | 1.4 | 1.6 | 24............ | 1.0 | 1.6 | 1.1 | 1.4 | 1.6 |
| 9............ | 1.0 | 1.1 | 1.0 | 1.3 | 1.6 | 25............ | 1.0 | 1.6 | 1.1 | 1.4 | 1.6 |
| 10............ | 1.0 | 1.0 | 1.0 | 1.2 | 1.6 | 26............ | 1.0 | 1.7 | 1.1 | 1.4 | 1.5 |
| 11............ | 1.0 | 1.0 | 1.0 | 1.2 | 1.6 | 27............ | 1.0 | 1.7 | 1.1 | 1.5 | 1.6 |
| 12............ | 1.6 | 1.0 | 1.0 | 1.2 | 1.6 | 28............ | 1.0 | 1.8 | 1.1 | 1.5 | 1.7 |
| 13............ | 1.6 | 1.0 | 1.2 | 1.1 | 1.6 | 29............ | .9 | ....... | 1.1 | 1.5 | 1.7 |
| 14............ | 1.7 | 1.0 | 1.2 | 1.1 | 1.5 | 30............ | .9 | ....... | 1.1 | 1.4 | 1.7 |
| 15............ | 1.7 | 1.0 | 1.2 | 1.2 | 1.4 | 31............ | .9 | ....... | 1.1 | ....... | 1.7 |
| 16............ | 1.8 | 1.2 | 1.2 | 1.2 | 1.4 | | | | | | |

## SUCCOR CREEK NEAR HOMEDALE, IDAHO.

This station was established March 19, 1903, by N. S. Dils. It was originally located at a small truss bridge built to carry a flume, about one-half mile above the mouth of the river. The station was moved January 31, 1905, about half a mile upstream to a location 1 mile west of Homedale and about 17 miles from Caldwell, the nearest railroad station. It is near the Caldwell-Jordan Valley stage road, 1 mile west of Mussel's ferry on Snake River, one-fourth mile below the head of the lowest ditch on Succor Creek, and about three-fourths of a mile above the mouth of the creek.

The river channel is straight for about 200 feet above and below the station. The bed of the stream is gravelly and has one channel at all stages. The right bank is low, slopes uniformly, and may overflow during high water. The left bank is high and not liable to overflow.

Discharge measurements are made from a cable and car. The initial point for soundings is the inside face of the cable support on the left bank of the stream.

The gage is an inclined staff on the left bank of the stream, about one-third mile above the house of Mrs. Minnie Tracy, who during 1905 read the gage once each day. The bench mark is a United States Geological Survey iron bench-mark post, 10 feet back from the gage; elevation, 9.88 feet above gage datum.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 440; 135, pp 195-196.
Discharge: 100, p 440; 135, p 196.
Discharge, monthly: 100, p 441.
Gage heights: 100, p 440; 135, p 196.
Rating table: 100, p 441.

*Discharge measurements of Succor Creek near Homedale, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 1 | W. C. Davies | 24 | 17 | 1.19 | 2.49 | 20 |
| February 24 | J. B. Bond | 34 | 36 | 3.00 | 3.20 | 108 |
| April 1 | La Rue and Bond | 32 | 24 | 2.17 | 2.90 | 52 |
| April 28 | E. C. La Rue | 27 | 17 | 1.24 | 2.55 | 21 |
| June 3 | do | 4 | 1.2 | 1.10 | 2.25 | 1.4 |

*Daily gage height, in feet, of Succor Creek near Homedale, Idaho, for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | Dec. |
|---|---|---|---|---|---|---|---|
| 1 | 3.65 | 2.5 | 2.7 | 3.1 | 2.3 | 2.45 | 1.9 |
| 2 | 3.55 | 2.3 | 2.7 | 3.3 | 2.2 | 2.35 | 1.9 |
| 3 | 3.5 | 2.3 | 2.75 | 3.4 | 2.25 | 2.2 | 1.9 |
| 4 | 3.5 | 2.4 | 2.7 | 3.2 | 2.35 | 2.4 | 1.95 |
| 5 | 3.45 | 2.45 | 2.7 | 3.1 | 2.35 | 2.9 | 1.95 |
| 6 | 3.45 | 2.3 | 2.7 | 3.0 | 2.35 | 2.6 | 1.95 |
| 7 | 3.45 | 2.4 | 2.65 | 2.95 | 2.25 | 2.7 | 1.95 |
| 8 | 3.45 | 2.35 | 2.6 | 2.9 | 2.25 | 3.75 | 1.95 |
| 9 | 3.45 | 2.25 | 2.6 | 2.85 | 2.2 | 2.8 | 1.95 |
| 10 | 3.45 | 2.4 | 2.6 | 2.95 | 2.2 | 2.7 | 1.95 |
| 11 | 3.45 | 2.2 | 2.65 | 2.95 | 2.1 | 2.7 | 1.95 |
| 12 | 3.45 | 2.4 | 2.65 | 2.75 | 2.25 | 6.85 | 1.95 |
| 13 | 3.45 | 2.4 | 2.6 | 2.7 | 2.15 | 2.5 | 1.95 |
| 14 | 3.45 | 2.4 | 2.65 | 2.65 | 2.1 | 2.5 | 1.9 |
| 15 | (a) | 2.5 | 2.65 | 2.7 | 2.1 | 2.3 | 1.9 |
| 16 | | 2.45 | 2.65 | 2.45 | 2.1 | 2.3 | 1.9 |
| 17 | | 2.5 | 2.65 | 2.45 | 1.9 | 2.2 | 1.9 |
| 18 | | 2.2 | 2.65 | 2.4 | 1.95 | 2.2 | 1.95 |
| 19 | | 2.2 | 2.65 | 2.4 | 2.0 | 2.15 | 1.95 |
| 20 | | 2.45 | 2.75 | 2.6 | 1.95 | 2.15 | 1.95 |
| 21 | | 3.45 | 2.7 | 2.65 | 1.9 | 2.1 | 1.95 |
| 22 | | 3.0 | 2.7 | 2.7 | 1.9 | 2.0 | 1.95 |
| 23 | | 3.2 | 2.65 | 2.6 | 1.9 | 2.0 | 1.95 |
| 24 | | 3.1 | 2.55 | 2.6 | 1.95 | 2.0 | 1.95 |
| 25 | | 3.0 | 2.65 | 2.7 | 1.95 | 2.0 | 1.95 |
| 26 | | 3.0 | 2.65 | 2.6 | 7.30 | 1.95 | 1.95 |
| 27 | | 2.8 | 3.4 | 2.6 | 2.85 | 1.9 | 1.95 |
| 28 | | 2.75 | 3.0 | 2.6 | 2.6 | 1.9 | 1.95 |
| 29 | | | 3.2 | 2.4 | 2.6 | 1.9 | 1.95 |
| 30 | | | 3.6 | 2.3 | 2.5 | 1.9 | 1.95 |
| 31 | | | 3.25 | | 2.5 | | 1.95 |

[a] Gage washed out.

NOTE.—Creek dry July 1 to November 30.

*Estimated monthly discharge of Succor Creek near Homedale, Idaho, for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January 1-14 | 203 | 154 | 161 | 4,470 |
| February | 154 | 1 | 29.2 | 1,622 |
| March | 189 | 22 | 47.0 | 2,890 |
| April | 143 | 3 | 46.3 | 2,755 |
| May | 2,500 | .2 | 86.3 | 5,306 |
| June | 2,050 | .2 | 86.7 | 5,159 |
| July | | | .0 | 0 |
| August | | | .0 | 0 |
| September | | | .0 | 0 |
| October | | | .0 | 0 |
| November | | | .0 | 0 |
| December | .3 | .2 | .28 | 17 |
| The period | | | | 22,220 |

NOTE.—These estimates are based on five discharge measurements and slope measurements and are only approximate.

## OWYHEE RIVER NEAR OWYHEE, OREG.

This station was established August 27, 1903, by John H. Lewis. It is located at the county bridge 1½ miles from Owyhee, Oreg. Owyhee ditch takes water from the river about 6 miles above.

The channel is straight for 200 feet above and 400 feet below the station. The current is sluggish at low water. The right bank is high and rocky and will not overflow. The left bank will overflow only at extreme high water. The bed of the stream is composed of sand and gravel and is liable to shift during freshets. There are two channels at low water and one at high water.

Discharge measurements are made from the bridge at ordinary stages and by wading above the bridge at extreme low water. The initial point for soundings is the center of the upstream caisson of the left abutment.

A standard chain gage is attached to the upstream side of the bridge, near the center of the left span; length of the chain, 26.40 feet. During 1905 the gage was read once each day by D. T. Rigsby and Gilder Watson. The bench mark is the top of the steel caisson at its outer edge directly above the old gage; elevation, 18.60 feet above the gage datum.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 131, pp 66-67; WS 100, pp 445-446; 135, pp 196-197.
Discharge: WS 100, p 446; 135, p 197.
Discharge, monthly: WS 135, p 199.
Discharge, flood: Ann 11, part 2, p 86.
Gage heights: Bull 131, p 67; WS 100, p 446; WS 135, p 197-198.
Rating table: Bull 131, p 67; WS 135, p 198.

*Discharge measurements of Owyhee River near Owyhee, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 26 | Smith and Johnson | 287 | 547 | 1.30 | 3.50 | 709 |
| March 6 | Smith and Griffin | 286 | 594 | 1.45 | 3.69 | 862 |
| March 13 | P. H. Johnson | 284 | 578 | 1.75 | 3.90 | 1,010 |
| March 25 | Johnson and Smith | 287 | 628 | 1.64 | 3.88 | 1,033 |
| April 14 | Smith and Griffin | 289 | 629 | 1.54 | 3.90 | 966 |
| May 12 | Griffin and Hall | 284 | 567 | 1.54 | 3.70 | 874 |
| June 6 | E. N. Smith | 286 | 566 | 1.26 | 3.55 | 710 |
| June 20 | do | 138 | 310 | 1.17 | 3.01 | 362 |
| July 3 | do | 128 | 235 | .44 | 2.38 | 104 |
| July 17[a] | Yates and Smith | 27 | 20 | .80 | 1.93 | 16 |
| August 15[a] | E. N. Smith | 27 | 17.2 | .43 | 1.89 | 7.4 |
| September 12[a] | W. C. Sawyer | 33 | 11.8 | .79 | 1.90 | 8.8 |
| October 13[a] | Sawyer and Hall | 44 | 21 | 1.17 | 2.03 | 25 |
| November 9 | R. S. Hall | 130 | 250 | .53 | 2.52 | 131 |
| December 28 | do | 130 | 244 | .87 | 3.05 | 212 |

[a] Wading ¼ mile above bridge.

*Daily gage height, in feet, of Owyhee River near Owyhee, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.2 | 3.1 | 3.75 | 4.0 | 4.3 | ....... | 2.45 | 1.8 | 1.85 | 1.9 | 2.3 | 2.78 |
| 2 | 3.0 | 3.15 | 3.8 | 4.1 | 4.25 | ....... | 2.4 | 1.8 | 1.85 | 2.0 | 2.3 | 2.78 |
| 3 | 2.9 | 3.1 | 3.7 | 4.0 | 4.2 | ....... | 2.38 | 1.8 | 1.88 | 2.0 | 2.31 | 2.7 |
| 4 | 2.8 | 3.15 | 3.65 | 4.9 | 4.05 | ....... | 2.35 | 1.8 | 1.85 | 1.9 | 2.31 | 2.68 |
| 5 | 2.75 | 3.1 | 3.6 | 3.8 | 4.05 | ....... | 2.25 | 1.8 | 1.85 | 2.0 | 2.31 | 2.68 |
| 6 | 2.8 | 3.1 | 3.6 | 4.1 | 4.1 | ....... | 2.25 | 1.8 | 1.85 | 2.0 | [c]2.5 | 2.58 |
| 7 | 3.0 | 3.05 | 3.8 | [a]4.15 | 4.05 | ....... | 2.0 | 1.8 | 1.85 | 2.0 | 2.5 | 2.68 |
| 8 | 2.9 | 3.1 | 3.9 | 4.0 | 4.0 | ....... | 2.05 | 1.8 | 1.85 | 1.95 | 2.5 | 2.68 |
| 9 | 2.95 | 3.05 | 3.95 | 3.9 | 4.05 | ....... | 2.05 | 1.8 | 1.85 | 1.95 | 2.5 | 2.68 |
| 10 | 2.9 | 2.6 | 4.0 | 3.9 | 3.9 | ....... | 2.0 | 1.8 | 2.0 | 2.0 | 2.5 | 2.68 |
| 11 | 3.0 | 2.6 | 3.95 | 3.85 | 3.8 | ....... | 1.95 | 1.8 | 1.9 | 2.05 | 2.5 | 2.68 |
| 12 | 2.9 | 3.05 | 3.9 | 3.9 | 3.7 | ....... | 1.95 | 1.8 | 1.9 | 2.05 | 2.5 | 2.68 |
| 13 | 3.0 | 3.2 | 3.95 | 4.0 | 3.7 | ....... | 1.95 | 1.8 | 1.9 | 2.03 | 2.52 | 2.68 |
| 14 | 2.9 | 3.35 | 4.0 | 3.9 | 3.8 | 3.35 | 1.95 | 1.8 | 1.9 | 2.03 | 2.52 | 2.75 |
| 15 | 3.1 | 3.2 | 4.1 | 3.8 | 3.85 | 3.25 | 1.9 | 1.8 | 1.9 | 2.03 | 2.6 | 2.78 |
| 16 | 3.2 | 3.0 | 4.0 | 3.8 | 3.9 | 3.2 | 1.9 | 1.8 | 1.9 | 2.05 | 2.6 | 2.98 |
| 17 | 4.9 | 2.9 | 4.1 | 3.8 | 3.9 | 3.15 | [b]2.15 | 1.8 | 2.0 | 2.05 | 2.61 | 2.98 |
| 18 | 4.7 | 3.2 | [a]4.0 | 3.75 | 3.85 | 3.1 | 1.9 | 1.82 | 1.9 | 2.05 | 2.6 | 2.98 |
| 19 | 4.6 | 3.15 | 3.2 | 3.7 | 3.8 | 3.05 | 1.9 | 1.82 | 1.9 | 2.05 | 2.6 | 2.88 |
| 20 | 4.0 | 3.0 | 3.8 | 3.7 | 3.85 | 3.0 | 1.85 | 1.83 | 1.9 | 2.05 | 2.6 | 2.95 |
| 21 | 3.5 | 3.2 | 3.6 | 3.8 | ....... | 2.96 | 1.85 | 1.85 | 1.9 | 2.05 | 2.6 | 2.65 |
| 22 | 3.3 | 3.6 | 3.5 | 3.95 | ....... | 2.9 | 1.85 | 1.9 | 1.9 | 2.1 | 2.6 | 2.68 |
| 23 | 3.6 | 3.65 | 3.6 | 4.3 | ....... | 2.85 | 1.85 | 1.9 | 1.95 | 2.1 | 2.6 | 2.68 |
| 24 | 5.0 | 4.9 | [b]4.1 | 4.7 | ....... | 2.79 | 1.85 | 1.9 | 2.0 | 2.1 | 2.6 | 2.78 |
| 25 | 4.2 | 4.5 | 3.9 | 4.0 | ....... | 2.75 | 1.85 | 1.9 | 1.95 | 2.12 | 2.62 | 2.88 |
| 26 | 3.6 | 3.9 | 3.7 | [b]4.5 | ....... | 2.75 | 1.84 | 1.9 | 1.9 | 2.10 | 2.62 | 2.98 |
| 27 | 3.5 | 4.0 | 3.6 | 4.3 | ....... | 2.6 | 1.83 | 1.85 | 1.95 | 2.15 | 2.62 | 2.98 |
| 28 | 3.45 | 3.8 | 3.55 | 4.3 | ....... | 2.55 | 1.82 | 1.85 | 1.9 | 2.15 | 2.62 | 3.05 |
| 29 | 3.5 | ....... | 3.9 | 4.35 | ....... | 2.55 | 1.82 | 1.85 | 1.9 | 2.15 | 2.62 | 3.05 |
| 30 | 3.4 | ....... | 4.15 | 4.4 | ....... | 2.55 | [b]2.45 | 1.85 | 1.95 | [c]2.3 | 3.0 | 3.05 |
| 31 | 3.3 | ....... | 4.1 | ....... | ....... | ....... | 1.87 | 1.85 | ....... | 2.3 | ....... | 3.05 |

[a] Water turned into Owyhee ditch.
[b] Water turned from Owyhee ditch into river.
[c] Part of water turned from Owyhee ditch into river.

NOTE.—No ice record.

*Station rating table for Owyhee River near Owyhee, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 4 | 2.70 | 208 | 3.50 | 673 | 4.30 | 1,410 |
| 1.90 | 10 | 2.80 | 254 | 3.60 | 748 | 4.40 | 1,525 |
| 2.00 | 20 | 2.90 | 304 | 3.70 | 826 | 4.50 | 1,650 |
| 2.10 | 38 | 3.00 | 358 | 3.80 | 910 | 4.60 | 1,780 |
| 2.20 | 58 | 3.10 | 414 | 3.90 | 1,000 | 4.70 | 1,920 |
| 2.30 | 80 | 3.20 | 473 | 4.00 | 1,095 | 4.80 | 2,070 |
| 2.40 | 104 | 3.30 | 535 | 4.10 | 1,195 | 4.90 | 2,220 |
| 2.50 | 132 | 3.40 | 602 | 4.20 | 1,300 | 5.00 | 2,380 |
| 2.60 | 168 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1905 and one during 1904. It is well defined throughout.

*Estimated monthly discharge of Owyhee River near Owyhee, Oreg., for 1905.*

[Drainage area, 9,875 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January [a] | 2,380 | 231 | 707 | 43,470 | 0.072 | 0.083 |
| February [a] | 2,200 | 168 | 600 | 33,320 | .061 | .064 |
| March | 1,248 | 473 | 941 | 57,860 | .095 | .110 |
| April | 2,220 | 826 | 1,173 | 69,800 | .119 | .133 |
| May 1-20 | 1,410 | 828 | 1,059 | 42,010 | .107 | .080 |
| June 14-30 | 568 | 150 | 317 | 10,690 | .032 | .020 |
| July | 118 | 5 | 31.9 | 1,962 | .0032 | .0037 |
| August | 10 | 4 | 5.7 | 349 | .00058 | .00067 |
| September | 20 | 7 | 10.8 | 643 | .0011 | .0012 |
| October | 80 | 10 | 31.4 | 1,931 | .0032 | .0037 |
| November | 358 | 80 | 151 | 8,985 | .015 | .017 |
| December [a] | 386 | 161 | 263 | 16,170 | .027 | .031 |
| The period | | | | 287,200 | | |

[a] Estimates may be somewhat large on account of possible ice condition.

NOTE.—To obtain the total discharge of Owyhee River the monthly estimates of Owyhee ditch should be added. See p. 120.

## DITCHES IN OWYHEE RIVER VALLEY, OREGON.

### OWYHEE DITCH NEAR OWYHEE, OREG.

This ditch diverts water from the left bank of Owyhee River, about 6 miles above Owyhee Bridge, which is used for a river gaging station.

The measurements were made just above Wilson's ranch, about 2 miles below the head of the ditch.

There are five wasteways on the ditch—the Fletcher, half a mile below the station; Cow Hollow, Lockett Gulch, Emerson, and one near the end of the ditch. The first two are above the river gaging station.

*Discharge measurements of Owyhee ditch near Owyhee, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| 1904. | | | | | | |
| June 18 | Sawyer and Torkelson | | | | ([a]) | 154 |
| July 1 | M. W. Torkelson | | | | | 207 |
| July 13 | do | | | | | 178 |
| August 10 | Torkelson and Smith | | | | | 142 |
| September 2 | E. N. Smith | | | | | 156 |
| September 12 | do | | | | | 111 |
| September 19 | do | | | | | 117 |
| October 12 | do | | | | | 41.9 |
| 1905. | | | | | | |
| March 24 | E. N. Smith | | 9.4 | 0.64 | 0.78 | 6.0 |
| April 14 | do | | 61.5 | 2.42 | 2.95 | 149 |
| May 12 | do | 27.3 | 67.3 | 2.68 | 3.12 | 180 |
| June 5 | do | 27.0 | 66.9 | 2.75 | 3.17 | 184 |
| July 17 | do | 27.5 | 65.5 | 2.39 | 3.00 | 157 |
| July 31 | do | 26.5 | 55.2 | 2.23 | 2.60 | 123 |
| July 31 | W. C. Sawyer | 26.5 | 55.2 | 2.19 | 2.60 | 121 |
| August 15 | E. N. Smith | 27.0 | 54.8 | 2.06 | 2.53 | 113 |
| September 12 | W. C. Sawyer | 26.5 | 53.6 | 1.99 | 2.65 | 107 |
| October 2 | Hawthorne and Griffin | 26.5 | 60.4 | 2.12 | 2.88 | 128 |
| October 13 | Sawyer and Hall | 26.5 | 59.4 | 2.26 | 2.85 | 134 |

[a] No gage established during 1904.

*Daily gage height, in feet, of Owyhee ditch near Owyhee, Oreg., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Day. | May. | June | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 2.5 | 17 | 3.5 | | 3.0 | 2.6 | |
| 2 | | 3.4 | | 2.6 | | 18 | | 3.0 | 3.3 | 2.6 | 2.8 |
| 3 | | | 3.4 | 2.5 | | 19 | 3.4 | | | 2.6 | |
| 4 | | | | 2.5 | 2.6 | 20 | | | 3.0 | | 2.7 |
| 5 | | 3.3 | | 2.5 | | 21 | | 2.8 | 2.9 | | |
| 6 | | | 3.4 | 2.5 | 2.65 | 22 | 3.5 | | 2.8 | 2.6 | |
| 7 | | 3.4 | 3.4 | 2.6 | | 23 | | 2.8 | | | 2.7 |
| 8 | | | 3.4 | 2.5 | 2.70 | 24 | 3.5 | | | 2.6 | |
| 9 | | 3.5 | 3.4 | 2.5 | | 25 | | 3.4 | | | 2.7 |
| 10 | | | | 2.5 | | 26 | 3.5 | | 2.8 | 2.6 | |
| 11 | 3.1 | 3.5 | | 2.6 | | 27 | | 3.6 | 2.7 | | 2.7 |
| 12 | 3.2 | | 3.3 | 2.3 | | 28 | | | 2.7 | | |
| 13 | 3.3 | | | 2.5 | | 29 | 3.5 | 3.5 | 2.65 | 2.55 | |
| 14 | | 3.1 | | 2.6 | | 30 | | | 2.5 | | |
| 15 | 3.5 | | | 2.5 | | 31 | 3.4 | | 2.6 | 2.5 | |
| 16 | | 3.0 | | 2.6 | | | | | | | |

*Station rating table for Owyhee ditch near Owyhee, Oreg., from March 24 to September 6, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.70 | 4.5 | 1.50 | 38 | 2.30 | 94 | 3.00 | 154 |
| .80 | 7 | 1.60 | 44 | 2.40 | 102 | 3.10 | 163 |
| .90 | 10 | 1.70 | 50 | 2.50 | 110 | 3.20 | 172 |
| 1.00 | 14 | 1.80 | 57 | 2.60 | 118 | 3.30 | 181 |
| 1.10 | 18 | 1.90 | 64 | 2.70 | 127 | 3.40 | 190 |
| 1.20 | 23 | 2.00 | 71 | 2.80 | 136 | 3.50 | 200 |
| 1.30 | 28 | 2.10 | 78 | 2.90 | 145 | 3.60 | 210 |
| 1.40 | 33 | 2.20 | 86 | | | | |

The above table is applicable only for open-channel conditions. It is based on seven discharge measurements made during 1905. It is well defined between gage heights 2.5 feet and 3 feet. The table has been extended beyond these limits. After September 6 the table does not apply on account of back water from a diversion wing.

*Estimated monthly discharge of Owyhee ditch near Owyhee, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May 11-31 | 200 | 163 | 194 | 8,080 |
| June | 210 | 136 | 177 | 10,530 |
| July | 190 | 110 | 162 | 9,961 |
| August | 118 | 94 | 114 | 7,010 |
| September | 127 | 107 | 114 | 6,783 |

*Discharge measurements of wasteways of Owyhee ditch in 1905.*

FLETCHER WASTEWAY NEAR OWYHEE, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| May 12 | E. N. Smith | 2.0 |
| October 13 | W. C. Sawyer | 6.3 |

COW HOLLOW WASTEWAY NEAR OWYHEE, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| May 12 | E. N. Smith | 1.5 |
| June 6 | do | 2.1 |
| October 2 | Hawthorne and Griffin | 5.1 |

LOCKETT'S GULCH WASTEWAY NEAR ARCADIA, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| May 11 | E. N. Smith | 1.4 |
| June 6 | do | 21.3 |
| October 3 | Hawthorne and Griffin | 14.6 |
| October 13 | Sawyer and Hall | 33.4 |

EMERSON WASTEWAY NEAR ARCADIA, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| May 11 | E. N. Smith | 6.3 |
| June 20 | do | 43.7 |
| July 3 | do | 20.3 |
| October 3 | Hawthorne and Griffin | 40.7 |
| October 14 | Sawyer and Hall | 54.1 |
| November 10 | R. S. Hall | 16.6 |

*Discharge measurements of wasteways of Owyhee ditch in 1905*—Continued.

WASTEWAY NEAR ONTARIO, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| October 14 | R. S. Hall | 1.8 |

### WILSON DITCH NEAR ONTARIO, OREG.

This ditch diverts water from the left bank of Snake River above Nyssa during the spring. All the water during the latter part of the last season was waste and seepage from the Owyhee ditch.

In 1904 measurements were made at Nyssa. The first measurement in 1905 was made at Nyssa, the last three 1 mile above Ontario, and the others about 2 miles above Ontario at Joseph Morton's ranch.

*Discharge measurements of Wilson ditch near Ontario, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| July 13 | M. W. Torkelson | 20.2 |
| August 10 | Torkelson and Smith | 3.3 |
| September 1 | E. N. Smith | 4.0 |
| 1905. | | |
| May 11 | E. N. Smith | 9.2 |
| May 19 | do | 9.0 |
| June 7 | do | 7.3 |
| July 3 | do | 8.5 |
| August 1 | do | 0.9 |
| August 16 | do | 1.3 |
| September 13 | W. C. Sawyer | 2.3 |
| October 14 | Sawyer and Hall | 5.2 |

### BOISE RIVER NEAR HIGHLAND, IDAHO.

This station was established on July 27, 1905, by E. C. La Rue, to replace the Boise station. A temporary station was maintained at Highland from March 23 to July 27, 1905. The permanent station is located 2 miles below the mouth of Moores Creek, 3 miles southwest of Highland post-office, about 8 miles above the old Boise station, and 15 miles east of Boise, the nearest railway point.

The channel is straight for 500 feet above the cable and 200 feet below. The water is rather swift during all stages. The right bank is very firm, rather steep, and not liable to overflow. The left bank is composed of broken lava rock and is rather steep, leading to a vertical lava cliff 30 feet in height. The bed of the stream is very firm, as it is composed of broken lava rock and granite bowlders.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the inner face of the right cable support.

The gage is an inclined staff in two sections on the right bank, 200 feet downstream from the cable support. During 1905 the gage was read once each day by Nettie Smythe. The bench mark is a United States Geological Survey aluminum tablet set in a large bowlder on the right bank, 400 feet below the cable support; elevation, 25.44 feet above the datum of the gage.

*Discharge measurements of Boise River near Highland, Idaho, in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 30 | E. C. La Rue | 183 | 726 | 2.50 | 4.30 | 1,815 |
| April 27 | do | 208 | 1,110 | 4.12 | 6.61 | 4,560 |
| May 25 | do | 207 | 852 | 3.79 | 6.20 | 3,233 |
| May 26 | do | 208 | 853 | 4.01 | 6.35 | 3,424 |
| July 19 | do | 185 | 408 | 2.40 | 3.70 | 981 |
| July 28 | do | 165 | 261 | 3.24 | [a] 3.55 | 845 |
| August 19 | do | 140 | 192 | 3.28 | [b] 3.15 | 630 |
| October 2 | do | 145 | 216 | 2.85 | 3.18 | 615 |
| October 19 | Grover and La Rue | 140 | 196 | 3.52 | 3.31 | 689 |

[a] Gage height at temporary station=3.30 on July 28.
[b] Gage height at temporary station=2.95 on August 19.

NOTE.—The first five measurements were made at the temporary station and the next four made at the permanent station.

*Daily gage height, in feet, of Boise River near Highland, Idaho, for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.1 | 5.85 | 8.0 | 5.2 | 3.5 | 3.0 | 3.2 | 3.35 | 3.25 |
| 2 | | 4.2 | 5.95 | 8.1 | 5.2 | 3.4 | 3.0 | 3.2 | 3.3 | 3.25 |
| 3 | | 4.25 | 6.05 | 7.9 | 5.1 | 3.4 | 3.0 | 3.15 | 3.3 | 3.25 |
| 4 | | 4.35 | 6.0 | 7.6 | 5.0 | 3.4 | 3.0 | 3.15 | 3.25 | 3.2 |
| 5 | | 4.5 | 5.85 | 7.5 | 4.9 | 3.4 | 3.0 | 3.15 | 3.25 | 3.0 |
| 6 | | 4.85 | 5.75 | 7.35 | 4.8 | 3.4 | 3.0 | 3.1 | 3.2 | 3.0 |
| 7 | | 5.3 | 5.75 | 7.3 | 4.7 | 3.3 | 3.0 | 3.1 | 3.2 | 2.9 |
| 8 | | 5.4 | 5.8 | 7.6 | 4.6 | 3.25 | 3.0 | 3.2 | 3.25 | 2.8 |
| 9 | | 5.5 | 6.1 | 7.6 | 4.5 | 3.2 | 3.0 | 3.2 | 3.3 | 2.8 |
| 10 | | 5.3 | 6.0 | 7.4 | 4.4 | 3.2 | 3.0 | 3.25 | 3.25 | 2.7 |
| 11 | | 5.1 | 5.75 | 7.4 | 4.35 | 3.2 | 3.0 | 3.25 | 3.25 | 2.7 |
| 12 | | 5.0 | 5.7 | 7.35 | 4.25 | 3.2 | 3.0 | 3.25 | 3.25 | 2.8 |
| 13 | | 5.1 | 5.55 | 7.45 | 4.15 | 3.2 | 3.0 | 3.25 | 3.25 | 2.9 |
| 14 | | 5.05 | 5.45 | 7.35 | 4.05 | 3.15 | 3.0 | 3.3 | 3.25 | 3.1 |
| 15 | | 5.05 | 5.5 | 7.05 | 4.0 | 3.15 | 3.0 | 3.3 | 3.25 | 3.25 |
| 16 | | 5.2 | 5.55 | 6.75 | 3.95 | 3.15 | 3.0 | 3.35 | 3.25 | 3.7 |
| 17 | | 5.35 | 6.1 | 6.6 | 3.85 | 3.15 | 3.0 | 3.4 | 3.25 | 3.7 |
| 18 | 4.45 | 5.25 | 7.0 | 6.5 | 3.8 | 3.15 | 3.05 | 3.35 | 3.25 | 3.7 |
| 19 | 4.35 | 5.5 | 7.1 | 6.1 | 3.75 | 3.15 | 3.05 | 3.3 | 3.25 | 3.6 |
| 20 | 4.15 | 5.8 | 7.1 | 5.95 | 3.7 | 3.1 | 3.05 | 3.25 | 3.25 | 3.5 |
| 21 | 4.1 | 5.8 | 7.1 | 6.1 | 3.65 | 3.1 | 3.05 | 3.3 | 3.25 | 3.45 |
| 22 | 4.1 | 5.75 | 6.75 | 6.0 | 3.6 | 3.05 | 3.05 | 3.35 | 3.3 | 3.0 |
| 23 | 4.1 | 5.9 | 6.7 | 5.95 | 3.55 | 3.05 | 3.05 | 3.35 | 3.3 | 2.9 |
| 24 | 4.1 | 5.9 | 6.5 | 5.9 | 3.45 | 3.05 | 3.05 | 3.4 | 3.3 | 2.9 |
| 25 | 4.1 | 6.2 | 6.3 | 5.9 | 3.4 | 3.05 | 3.1 | 3.45 | 3.3 | 3.05 |
| 26 | 4.45 | 6.5 | 6.35 | 5.8 | 3.35 | 3.05 | 3.1 | 3.4 | 3.3 | 3.15 |
| 27 | 4.6 | 6.6 | 7.2 | 5.7 | 3.3 | 3.05 | 3.15 | 3.35 | 3.3 | 3.15 |
| 28 | 4.35 | 6.3 | 7.0 | 5.6 | 3.3 | 3.05 | 3.15 | 3.35 | 3.3 | 3.4 |
| 29 | 4.35 | 6.1 | 7.6 | 5.45 | 3.25 | 3.0 | 3.2 | 3.35 | 3.25 | 3.5 |
| 30 | 4.3 | 6.0 | 7.4 | 5.3 | 3.2 | 3.0 | 3.2 | 3.35 | 3.25 | 3.4 |
| 31 | 4.1 | | 7.45 | | 3.15 | 3.0 | | 3.35 | | 3.25 |

NOTE.—No ice record.

*Daily discharge, in second-feet, of Boise River near Highland, Idaho, for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1,650 | 3,350 | 6,070 | 2,150 | 820 | 560 | 650 | 730 | 675 |
| 2 | ........ | 1,710 | 3,470 | 6,260 | 2,150 | 760 | 560 | 650 | 700 | 675 |
| 3 | ........ | 1,750 | 3,590 | 5,890 | 2,060 | 760 | 560 | 625 | 700 | 675 |
| 4 | ........ | 1,840 | 3,490 | 5,380 | 1,970 | 760 | 560 | 625 | 675 | 650 |
| 5 | ........ | 1,970 | 3,260 | 5,180 | 1,870 | 760 | 560 | 625 | 675 | 560 |
| 6 | ........ | 2,320 | 3,100 | 4,940 | 1,790 | 760 | 560 | 600 | 650 | 560 |
| 7 | ........ | 2,810 | 3,080 | 4,860 | 1,710 | 700 | 560 | 600 | 650 | 520 |
| 8 | ........ | 2,920 | 3,120 | 5,360 | 1,630 | 675 | 560 | 650 | 675 | 480 |
| 9 | ........ | 3,050 | 3,510 | 5,360 | 1,550 | 650 | 560 | 650 | 700 | 480 |
| 10 | ........ | 2,810 | 3,350 | 5,010 | 1,470 | 650 | 560 | 675 | 675 | 450 |
| 11 | ........ | 2,570 | 2,980 | 5,010 | 1,430 | 650 | 560 | 675 | 675 | 450 |
| 12 | ........ | 2,470 | 2,900 | 4,920 | 1,350 | 650 | 560 | 675 | 675 | 480 |
| 13 | ........ | 2,570 | 2,710 | 5,090 | 1,270 | 650 | 560 | 675 | 675 | 520 |
| 14 | ........ | 2,490 | 2,580 | 4,930 | 1,210 | 625 | 560 | 700 | 675 | 600 |
| 15 | ........ | 2,490 | 2,610 | 4,460 | 1,170 | 625 | 560 | 700 | 675 | 675 |
| 16 | ........ | 2,660 | 2,650 | 4,000 | 1,140 | 625 | 560 | 730 | 675 | 940 |
| 17 | ........ | 2,820 | 3,300 | 3,990 | 1,070 | 625 | 560 | 760 | 675 | 940 |
| 18 | 1,930 | 2,710 | 4,600 | 3,650 | 1,030 | 625 | 580 | 730 | 675 | 940 |
| 19 | 1,850 | 2,980 | 4,740 | 3,110 | 1,010 | 625 | 580 | 700 | 675 | 880 |
| 20 | 1,660 | 3,380 | 4,710 | 2,930 | 990 | 600 | 580 | 675 | 675 | 820 |
| 21 | 1,630 | 3,380 | 4,670 | 3,120 | 970 | 600 | 580 | 700 | 675 | 790 |
| 22 | 1,630 | 3,320 | 4,100 | 2,990 | 950 | 580 | 580 | 730 | 700 | 560 |
| 23 | 1,630 | 3,540 | 3,990 | 2,930 | 930 | 580 | 580 | 730 | 700 | 520 |
| 24 | 1,640 | 3,540 | 3,670 | 2,880 | 880 | 580 | 580 | 760 | 700 | 520 |
| 25 | 1,640 | 3,950 | 3,360 | 2,880 | 860 | 580 | 600 | 790 | 700 | 580 |
| 26 | 1,940 | 4,410 | 3,430 | 2,770 | 840 | 580 | 600 | 760 | 700 | 625 |
| 27 | 2,090 | 4,570 | 4,700 | 2,670 | 820 | 580 | 625 | 730 | 700 | 625 |
| 28 | 1,860 | 4,070 | 4,380 | 2,560 | 820 | 580 | 625 | 730 | 700 | 760 |
| 29 | 1,860 | 3,760 | 5,360 | 2,390 | 810 | 560 | 650 | 730 | 675 | 820 |
| 30 | 1,820 | 3,590 | 5,030 | 2,240 | 780 | 560 | 650 | 730 | 675 | 760 |
| 31 | 1,650 | ........ | 5,120 | ........ | 750 | 560 | ........ | 730 | ........ | 675 |

NOTE.—March 18 to July 31 discharge obtained indirectly; August 1 to December 31 discharge obtained from rating table based on four measurements made at permanent station.

*Estimated monthly discharge of Boise River near Highland, Idaho, for 1905.*

[Drainage area, 2,614 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| March 18-31 | 2,090 | 1,630 | 1,774 | 49,260 | 0.679 | 0.354 |
| April | 4,570 | 1,650 | 2,937 | 174,800 | 1.12 | 1.25 |
| May | 5,360 | 2,580 | 3,707 | 227,900 | 1.42 | 1.64 |
| June | 6,260 | 2,240 | 4,121 | 245,200 | 1.58 | 1.76 |
| July | 2,150 | 750 | 1,272 | 78,210 | .487 | .562 |
| August | 820 | 560 | 643 | 39,540 | .246 | .284 |
| September | 650 | 560 | 578 | 34,390 | .221 | .247 |
| October | 790 | 600 | 693 | 42,610 | .265 | .306 |
| November | 730 | 650 | 684 | 40,700 | .262 | .292 |
| December | 940 | 450 | 652 | 40,090 | .249 | .287 |
| The period | ........ | ........ | ........ | 972,700 | ........ | ........ |

## MALHEUR RIVER NEAR WESTFALL, OREG.

This station was established December 15, 1903, by John H. Lewis, and was discontinued October 31, 1905. It is located 3 miles below the Harper ranch, near Westfall, 22 miles above Vale, Oreg.

The channel is straight for about 1,000 feet above and 200 feet below the station and the current is swift. The right bank is low, covered with sage brush, and overflows during high water. The left bank is high, rocky, and not liable to overflow. The bed of the stream is composed of gravel and sand and is free from vegetation and shifting. There is but one channel at low water and the main channel and two sloughs at high stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the zero of the tagged wire.

The original gage was a staff attached vertically to a frame bent of a bridge which formerly occupied this site, on the left bank. An inclined gage was established on the right bank, 50 feet above the cable, July 27, 1904, the datum being changed. During 1905 the gage was read at varying intervals by Clarence Vines. The bench mark is a nail in the top of the post to which the stay wire is fastened; elevation, 15.92 feet above the datum of the inclined gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 427-428; 135, p 203.
Discharge: 100, p 428; 135, p 204.
Discharge, monthly: 135, p 205.
Gage heights: 100, p 428; 135, p 204.
Rating table: 135, p 205.

*Discharge measurements of Malheur River near Westfall, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet* | *Feet per second.* | *Feet* | *Second-feet.* |
| February 6 | Smith and Griffin | 188 | 135 | 2.12 | 5.78 | 286 |
| March 3 | Smith and Johnson | 195 | 437 | 3.70 | 7.09 | 1,613 |
| March 4 | E. N. Smith | 197 | 459 | 3.65 | 7.20 | 1,680 |
| March 13 | do | 202 | 532 | 3.74 | 7.72 | 1,990 |
| March 14 | do | 202 | 550 | 4.10 | 7.82 | 2,250 |
| March 28 | J. M. Griffin | 193 | 303 | 3.42 | 6.70 | 1,035 |
| April 17 | do | 192 | 232 | 2.44 | 6.40 | 567 |
| May 19 | Griffin and Smith | 189 | 133 | 2.48 | 5.83 | 304 |
| June 13 | E. N. Smith | 189 | 157 | 2.38 | 5.89 | 374 |
| June 19 | do | 188 | 119 | 2.00 | 5.70 | 236 |
| July 18 | Smith and Yates | 44 | 32 | 1.38 | 5.13 | 44 |
| September 1 | E. N. Smith | 34 | 20 | 1.01 | 4.94 | 20 |

*Daily gage height, in feet, of Malheur River near Westfall, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | 6.5 | 6.2 | 5.9 | | | | |
| 2 | | | | 6.5 | 6.2 | | 5.5 | | 4.9 | |
| 3 | | | 7.1 | 6.7 | 6.2 | | | | | |
| 4 | | | 7.2 | 6.9 | 6.1 | | | | | |
| 5 | | | 7.0 | 7.0 | 6.1 | 5.8 | | 4.9 | | |
| 6 | | | 7.0 | 6.7 | 6.1 | | | | | |
| 7 | | | 7.1 | 6.6 | 6.0 | | 5.4 | | | 5.3 |
| 8 | | | 7.0 | 6.6 | 6.0 | | | | | |
| 9 | | | 6.8 | 6.7 | 6.0 | 5.8 | | | 5.0 | |
| 10 | | | 6.9 | 6.7 | 6.0 | | | | | |
| 11 | | | 7.1 | 6.7 | 6.0 | | 5.3 | | | |
| 12 | | | 7.4 | 6.7 | 6.0 | | | 4.6 | | |
| 13 | | | 7.7 | 6.6 | 6.0 | 5.9 | | | | |
| 14 | | | 7.8 | 6.5 | 5.9 | | 5.2 | | | 5.4 |
| 15 | | | 7.4 | 6.5 | 5.8 | | | | | |
| 16 | | | 7.2 | 6.5 | 5.8 | 5.8 | | | 5.1 | |
| 17 | | | 7.1 | 6.4 | 5.7 | | | | | |
| 18 | | | 6.9 | 6.4 | 5.7 | | 5.1 | | | |
| 19 | | | 6.9 | 6.4 | 5.6 | 5.6 | | | | |
| 20 | | | 7.0 | 6.4 | | | | | | |
| 21 | | | 7.4 | 6.4 | | | 5.0 | | | 5.5 |
| 22 | | | 7.2 | 6.4 | 5.6 | | | 4.95 | | |
| 23 | | | 6.9 | 6.3 | | 5.6 | | | 5.2 | |
| 24 | 9.0 | | 6.9 | 6.3 | | | | | | |
| 25 | 7.3 | | 6.9 | 6.3 | | | | | | |
| 26 | 7.0 | | 6.7 | 6.3 | 5.7 | 5.5 | | 4.9 | | |
| 27 | 6.5 | | 6.7 | 6.3 | | | | | | |
| 28 | | | 6.7 | 6.3 | | | 4.9 | | | 5.6 |
| 29 | | | 6.6 | 6.3 | | | | | | |
| 30 | | | 6.6 | 6.2 | 6.7 | 5.5 | | | 5.2 | |
| 31 | | | 6.5 | | | | 4.9 | | | |

NOTE.—Owing to distance of observer from gage, daily readings were made only during high water.

*Station rating table for Malheur River near Westfall, Oreg., from January 1 to October 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.60 | 15 | 5.80 | 297 | 6.90 | 1,242 | 8.00 | 2,580 |
| 4.70 | 16 | 5.90 | 360 | 7.00 | 1,350 | 8.10 | 2,725 |
| 4.80 | 17 | 6.00 | 430 | 7.10 | 1,459 | 8.20 | 2,874 |
| 4.90 | 19 | 6.10 | 503 | 7.20 | 1,569 | 8.30 | 3,028 |
| 5.00 | 25 | 6.20 | 580 | 7.30 | 1,681 | 8.40 | 3,187 |
| 5.10 | 40 | 6.30 | 661 | 7.40 | 1,796 | 8.50 | 3,350 |
| 5.20 | 59 | 6.40 | 747 | 7.50 | 1,915 | 8.60 | 3,515 |
| 5.30 | 82 | 6.50 | 840 | 7.60 | 2,038 | 8.70 | 3,682 |
| 5.40 | 110 | 6.60 | 936 | 7.70 | 2,165 | 8.80 | 3,851 |
| 5.50 | 146 | 6.70 | 1,035 | 7.80 | 2,298 | 8.90 | 4,024 |
| 5.60 | 189 | 6.80 | 1,137 | 7.90 | 2,437 | 9.00 | 4,200 |
| 5.70 | 239 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905. It is fairly well defined throughout.

*Estimated monthly discharge of Malheur River near Westfall, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March 3-31 | 2,298 | 840 | 1,386 | 79,730 |
| April | 1,350 | 580 | 850 | 50,580 |
| May | 1,035 | 189 | 413 | 25,390 |
| June | 360 | 146 | 253 | 15,050 |
| July | 146 | 19 | 62.5 | 3,843 |
| August | 21 | 15 | 18.5 | 1,138 |
| September | 59 | 19 | 40.4 | 2,404 |
| October | 189 | 82 | 132 | 8,116 |
| The period | | | | 186,300 |

NOTE.—Gage heights were interpolated for days when there was no reading.

## MALHEUR RIVER AT VALE, OREG.

This station was established May 20, 1903, by N. S. Dils. It is located at the steel highway bridge one-eighth mile southeast of Vale, Oreg. A station has been maintained here at intervals since 1890.

The channel is straight for about 200 feet above and 300 feet below the station, and the current is swift. The right bank is high, rocky, free from vegetation, and does not overflow. The left bank is low, and is composed of firm earth, covered with small sagebrush, and is liable to overflow at high water, when the water flows in two sloughs on the left bank, which can be measured by wading. The bed of the stream is composed of gravel and sand and is free from vegetation and liable to shift. There is but one channel at all stages, with the exception of the above-mentioned sloughs. The lower portion of the drainage area is covered with sagebrush, and the snow is melted very rapidly by warm winds, causing sudden floods of considerable height but of short duration.

Discharge measurements were originally made from the upstream side of the bridge. March 2, 1904, a cable, car, and tagged and stay wires were installed about one-fourth mile downstream, directly opposite the town of Vale. The initial point for soundings is the zero of the tagged wire on the left bank.

The original gage was replaced July 25, 1904, by a standard chain gage attached to the downstream side of the bridge, near the center of the span; length of chain, 30.41 feet. The datum is the same. During 1905 the gage was read twice each day by Isaac McCumsey and Z. G. Wilson. The bench mark is the top surface of the east steel caisson at the north end of the bridge; elevation, 21.63 feet above the datum of the gage and 2,236.56 feet above sea level.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; Bull=Bulletin; WS=Water-Supply Paper):

Description: Ann 18, iv, p 348; Bull 131, p 68; 140, p 242; WS 16, p 169; 100, pp 424-425; 135, p 206.

Discharge: Ann 11, ii, p 88; 18, iv, p 348; Bull 131, pp 68, 92; 140, p 242; WS 16, p 169; 100, p 425; 135, p 207.

Discharge, monthly: Ann 11, ii, p 106; 12, ii, pp 358, 361; 13, iii, p 98; 18, iv, pp 349-350; WS 100, p 427; 135, p 208.

Discharge, yearly: Ann 13, iii, p 99; 20, iv, p 62.

Gage heights: Bull 140, p 243; WS 11, p 83; 16, p 169; 100, p 426; 135, p 207.

Hydrograph: Ann 12, ii, p 344.

Rating tables: Ann 18, iv, p 349; WS 100, p 426; 135, p 208.

*Discharge measurements of Malheur River at Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 25 | Smith and Johnson | 148 | 647 | 2.95 | 7.00 | 1,900 |
| January 28 | do | 117 | 360 | 2.20 | 5.50 | 800 |
| February 4 | do | 105 | 250 | 1.22 | 4.68 | 306 |
| February 8 | E. N. Smith | 102 | 228 | .99 | 4.40 | 226 |
| February 23 | Smith and Griffin | 140 | 453 | 2.55 | 6.15 | 1,155 |
| February 24 | do | 148 | 570 | 3.74 | 7.00 | 2,130 |
| March 2 | E. N. Smith | 139 | 560 | 2.90 | 6.46 | 1,620 |
| March 9 | J. M. Griffin | 133 | 491 | 2.87 | 6.45 | 1,405 |
| March 14 | P. H. Johnson | 150 | 764 | 3.38 | 7.35 | 2,580 |
| March 18 | do | 144 | 540 | 2.87 | 6.40 | 1,550 |
| March 22 | Smith and Johnson | 141 | 570 | 3.13 | 6.80 | 1,780 |
| March 27 | do | 134 | 465 | 2.75 | 6.08 | 1,281 |
| April 11 | J. M. Griffin | 138 | 435 | 2.56 | 6.10 | 1,110 |
| April 19 | do | 130 | 350 | 2.10 | 5.60 | 740 |
| April 26 | do | 123 | 280 | 1.90 | 5.30 | 533 |
| May 17 | do | 101 | 166 | 1.07 | 4.40 | 178 |
| June 5 | E. N. Smith | 109 | 235 | 1.46 | 4.70 | 343 |
| June 12 | do | 108 | 227 | 1.76 | 5.00 | 410 |
| June 26 | do | 100 | 146 | .79 | 4.15 | 115 |
| July 4 | do | 92 | 120 | .67 | 3.90 | 80 |
| July 10 | do | 92 | 95 | .40 | 3.78 | 38.0 |
| July 21 | do | 21 | 30 | 1.15 | 3.71 | 34.7 |
| July 29 | do | 20 | 25 | 1.10 | 3.67 | 27.6 |
| August 4 | do | 20 | 22 | 1.02 | 3.62 | 22.5 |
| August 11 | do | 20 | 18.3 | 1.09 | 3.59 | 16.9 |
| August 17 | do | 19 | 17.3 | .79 | 3.58 | 13.7 |
| September 8 | G. Stubblefield | 20 | 19.7 | .95 | 3.62 | 18.7 |
| October 14 | R. S. Hall | 10 | 9.4 | 4.75 | 3.90 | 48 |
| November 4 | do | 38 | 52 | 1.72 | 4.10 | 90 |
| December 27 | do | 99 | 136 | 85 | 4.30 | 115 |

*Daily gage height, in feet, of Malheur River at Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.35 | 4.85 | 6.35 | 5.9 | 5.13 | 4.45 | 4.0 | 3.62 | 3.56 | 3.8 | 4.15 | 4.28 |
| 2 | 4.75 | 4.7 | 6.5 | 6.0 | 5.1 | 4.47 | 4.0 | 3.63 | 3.57 | 3.81 | 4.06 | 4.19 |
| 3 | 4.6 | 4.7 | 6.55 | 6.3 | 5.1 | 4.38 | 4.0 | 3.6 | 3.58 | 3.84 | 4.08 | 4.29 |
| 4 | 4.8 | 4.7 | 6.45 | 6.45 | 4.97 | 4.45 | 3.9 | 3.6 | 3.6 | 3.86 | 4.1 | 4.43 |
| 5 | 4.7 | 4.6 | 6.7 | 6.25 | 4.92 | 4.7 | 3.9 | 3.57 | 3.6 | 3.86 | 4.11 | 4.41 |
| 6 | 4.6 | 4.6 | 6.6 | 5.97 | 4.88 | 4.6 | 3.9 | 3.6 | 3.6 | 3.88 | 4.16 | 4.35 |
| 7 | 4.6 | 4.55 | 6.75 | 5.9 | 4.77 | 4.7 | 3.85 | 3.59 | 3.6 | 3.88 | 4.14 | 4.37 |
| 8 | 4.6 | 4.5 | 6.75 | 6.23 | 4.7 | 5.05 | 3.85 | 3.56 | 3.62 | 3.86 | 4.16 | 4.4 |
| 9 | 4.4 | 4.45 | 6.45 | 6.3 | 4.63 | 5.05 | 3.77 | 3.54 | 3.63 | 3.86 | 4.17 | 4.05 |
| 10 | 4.2 | 4.45 | 6.4 | 6.13 | 4.6 | 5.02 | 3.73 | 3.59 | 3.63 | 3.88 | 4.16 | 4.36 |
| 11 | 4.25 | 4.4 | 6.5 | 6.12 | 4.52 | 5.1 | 3.7 | 3.56 | 3.66 | 3.86 | 4.2 | 4.31 |
| 12 | 4.25 | 4.45 | 6.8 | 6.0 | 4.5 | 4.97 | 3.65 | 3.59 | 3.68 | 3.9 | 4.16 | 3.9 |
| 13 | 4.25 | 4.25 | 7.1 | 5.85 | 4.5 | 4.85 | 3.62 | 3.58 | 3.68 | 3.9 | 4.18 | 3.79 |
| 14 | 4.35 | 4.4 | 7.3 | 5.85 | 4.5 | 4.7 | 3.6 | 3.54 | 3.69 | 3.9 | 4.11 | 3.92 |
| 15 | 4.15 | 4.5 | 7.15 | 5.78 | 4.45 | 4.63 | 3.6 | 3.54 | 3.68 | 3.9 | 4.19 | 4.24 |
| 16 | 4.30 | 4.55 | 6.7 | 5.67 | 4.4 | 4.52 | 3.68 | 3.49 | 3.69 | 3.98 | 4.2 | 4.15 |
| 17 | 4.55 | 4.5 | 6.5 | 5.55 | 4.33 | 4.5 | 3.67 | 3.54 | 3.72 | 4.01 | 4.21 | 4.2 |

*Daily gage height, in feet, of Malheur River at Vale, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 5.4 | 4.4 | 6.4 | 5.5 | 4.2 | 4.45 | 3.7 | 3.54 | 3.76 | 4.07 | 4.26 | 4.28 |
| 19 | 5.05 | 4.35 | 6.45 | 5.6 | 4.2 | 4.65 | 3.75 | 3.55 | 3.78 | 4.06 | 4.2 | 4.3 |
| 20 | 5.4 | 4.5 | 6.45 | 5.5 | 4.2 | 4.4 | 3.75 | 3.58 | 3.79 | 4.1 | 4.24 | 4.36 |
| 21 | 5.35 | 4.6 | 6.8 | 5.5 | 4.2 | 4.32 | 3.7 | 3.58 | 3.8 | 4.12 | 4.24 | 4.47 |
| 22 | 5.15 | 5.95 | 6.8 | 5.5 | 4.2 | 4.25 | 3.7 | 3.59 | 3.8 | 4.1 | 4.22 | 4.82 |
| 23 | 5.6 | 6.3 | 6.55 | 5.43 | 4.17 | 4.2 | 3.65 | 3.59 | 3.82 | 4.08 | 4.18 | 4.72 |
| 24 | 7.95 | 6.95 | 6.45 | 5.42 | 4.15 | 4.15 | 3.65 | 3.6 | 3.84 | 4.1 | 4.08 | 4.3 |
| 25 | 6.92 | 7.25 | 6.35 | 5.4 | 4.15 | 4.15 | 3.65 | 3.61 | 3.82 | 4.12 | 4.18 | 4.42 |
| 26 | 6.17 | 7.1 | 6.22 | 5.35 | 4.15 | 4.15 | 3.62 | 3.59 | 3.82 | 4.1 | 4.26 | 4.31 |
| 27 | 5.74 | 6.85 | 6.08 | 5.28 | 4.25 | 4.1 | 3.6 | 3.57 | 3.83 | 4.13 | 4.31 | 4.27 |
| 28 | 5.5 | 6.55 | 6.12 | 5.3 | 4.6 | 4.5 | 3.6 | 3.58 | 3.84 | 4.14 | 4.34 | 4.64 |
| 29 | 5.35 | ....... | 6.05 | 5.32 | 4.58 | 4.0 | 3.6 | 3.57 | 3.82 | 4.18 | 4.33 | 4.5 |
| 30 | 5.15 | ....... | 5.98 | 5.23 | 4.9 | 4.3 | 3.62 | 3.58 | 3.83 | 4.14 | 4.34 | 4.34 |
| 31 | 5.0 | ....... | 5.9 | ....... | 4.65 | ....... | 3.63 | 3.57 | ....... | 4.14 | ....... | 4.31 |

**Note.**—Ice conditions during part of January and December.

*Daily discharge, in second-feet, of Malheur River at Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 132 | 386 | 1,524 | 1,088 | 452 | 239 | 88 | 20 | 14 | 44 | 109 | 140 |
| 2 | 258 | 318 | 1,673 | 1,168 | 436 | 247 | 98 | 22 | 15 | 46 | 90 | 118 |
| 3 | 204 | 318 | 1,725 | 1,382 | 436 | 214 | 98 | 18 | 16 | 50 | 94 | 142 |
| 4 | 277 | 318 | 1,673 | 1,524 | 372 | 239 | 78 | 18 | 18 | 54 | 98 | 182 |
| 5 | 239 | 277 | 1,778 | 1,338 | 349 | 340 | 78 | 15 | 18 | 54 | 100 | 176 |
| 6 | 204 | 277 | 1,572 | 1,065 | 331 | 298 | 78 | 18 | 18 | 57 | 111 | 159 |
| 7 | 204 | 277 | 1,778 | 1,013 | 285 | 318 | 60 | 17 | 18 | 57 | 107 | 165 |
| 8 | 204 | 258 | 1,725 | 1,276 | 277 | 490 | 60 | 14 | 20 | 54 | 111 | 173 |
| 9 | 145 | 239 | 1,426 | 1,293 | 250 | 462 | 40 | 12 | 22 | 54 | 113 | 88 |
| 10 | 98 | 239 | 1,382 | 1,151 | 239 | 446 | 34 | 17 | 22 | 57 | 111 | 162 |
| 11 | 109 | 222 | 1,475 | 1,143 | 211 | 462 | 30 | 14 | 25 | 54 | 120 | 148 |
| 12 | 109 | 239 | 1,887 | 1,050 | 204 | 396 | 24 | 17 | 28 | 60 | 111 | 60 |
| 13 | 109 | 159 | 2,237 | 940 | 204 | 340 | 20 | 16 | 28 | 60 | 116 | 43 |
| 14 | 132 | 204 | 2,486 | 940 | 204 | 277 | 18 | 12 | 29 | 60 | 100 | 64 |
| 15 | 88 | 239 | 2,298 | 890 | 188 | 250 | 18 | 12 | 28 | 60 | 118 | 130 |
| 16 | 120 | 258 | 1,778 | 814 | 173 | 211 | 28 | 7 | 29 | 74 | 120 | 109 |
| 17 | 188 | 222 | 1,622 | 733 | 153 | 204 | 26 | 12 | 34 | 80 | 122 | 120 |
| 18 | 575 | 188 | 1,524 | 700 | 120 | 188 | 30 | 12 | 38 | 92 | 135 | 140 |
| 19 | 386 | 173 | 1,572 | 766 | 120 | 258 | 37 | 13 | 41 | 90 | 120 | 145 |
| 20 | 575 | 222 | 1,524 | 700 | 120 | 173 | 37 | 16 | 43 | 98 | 130 | 162 |
| 21 | 546 | 239 | 1,832 | 700 | 120 | 151 | 30 | 16 | 44 | 102 | 130 | 195 |
| 22 | 436 | 1,013 | 1,778 | 700 | 132 | 132 | 30 | 17 | 44 | 98 | 125 | 327 |
| 23 | 706 | 1,293 | 1,524 | 624 | 125 | 120 | 24 | 17 | 47 | 94 | 116 | 285 |
| 24 | 3,098 | 2,058 | 1,475 | 618 | 120 | 109 | 24 | 18 | 50 | 98 | 94 | 145 |
| 25 | 1,800 | 2,423 | 1,428 | 605 | 120 | 109 | 24 | 19 | 47 | 102 | 116 | 179 |
| 26 | 1,168 | 2,237 | 1,355 | 575 | 120 | 109 | 20 | 17 | 47 | 98 | 135 | 148 |
| 27 | 911 | 2,000 | 1,281 | 534 | 159 | 98 | 18 | 15 | 50 | 105 | 148 | 138 |
| 28 | 800 | 1,673 | 1,225 | 546 | 277 | 204 | 18 | 16 | 50 | 107 | 156 | 254 |
| 29 | 700 | ....... | 1,250 | 558 | 269 | 88 | 18 | 15 | 47 | 116 | 153 | 204 |
| 30 | 575 | ....... | 1,192 | 506 | 410 | 159 | 20 | 16 | 48 | 107 | 156 | 156 |
| 31 | 490 | ....... | 1,088 | ....... | 298 | ....... | 22 | 15 | ....... | 107 | ....... | 148 |

**Note.**—Owing to changeable bed the daily discharge has been obtained indirectly.

*Estimated monthly discharge of Malheur River at Vale, Oreg., for 1905.*

[Drainage area, 4,190 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3,098 | 88 | 503 | 30,930 | 0.120 | 0.138 |
| February | 2,423 | 159 | 642 | 35,660 | .153 | .159 |
| March | 2,486 | 1,088 | 1,616 | 99,360 | .386 | .445 |
| April | 1,524 | 506 | 898 | 53,440 | .214 | .239 |
| May | 452 | 120 | 235 | 14,450 | .056 | .065 |
| June | 490 | 88 | 244 | 14,520 | .058 | .065 |
| July | 98 | 18 | 39.6 | 2,435 | .0095 | .011 |
| August | 22 | 7 | 15.6 | 959 | .0037 | .0043 |
| September | 50 | 14 | 32.6 | 1,940 | .0078 | .0087 |
| October | 116 | 44 | 77.1 | 4,741 | .018 | .021 |
| November | 156 | 90 | 119 | 7,081 | .028 | .031 |
| December | 327 | 43 | 155 | 9,531 | .037 | .043 |
| The year | 3,098 | 7 | 381 | 275,000 | .098 | 1.23 |

NOTE.—Estimates during January and December may be slightly large owing to ice conditions.

### MALHEUR RIVER AT M'LAUGHLIN'S BRIDGE, NEAR VALE, OREG.

This station was established December 10, 1904, by W. C. Sawyer. It is located at the new county bridge, known as McLaughlin's bridge, 10 miles above Vale, Oreg.

Discharge measurements are made from the iron bridge to which the gage is fastened, consisting of two spans and wooden approaches.

A standard chain gage is attached to the upstream hand rail of the bridge, near the left bank; length of the chain, 21.72 feet. In 1905 the gage was read weekly during a portion of January and February and daily during the remainder of the year by R. N. Linebarger.

A description of this station is contained in Water-Supply Paper No. 135, United States Geological Survey, page 109.

*Discharge measurements of Malheur River at McLaughlin's bridge, near Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 28 | Smith and Johnson | 84 | 160 | 4.56 | 3.80 | 730 |
| February 27 | .....do | 110 | 310 | 4.87 | 4.70 | 1,510 |
| March 2 | Griffin and Johnson | 98 | 290 | 4.55 | 4.50 | 1,320 |
| March 12 | E. N. Smith | 112 | 355 | 4.93 | 5.00 | 1,750 |
| March 14 | .....do | 153 | 409 | 5.21 | 5.41 | 2,133 |
| April 1 | Smith and Griffin | 96 | 223 | 4.35 | 4.00 | 970 |
| April 17 | J. M. Griffin | 90 | 260 | 3.43 | 3.90 | 890 |
| April 30 | .....do | 112 | 127 | 3.76 | 3.60 | 478 |
| May 6 | .....do | 79 | 138 | 3.15 | 3.35 | 434 |
| May 16 | .....do | 76 | 128 | 2.30 | 3.00 | 294 |
| June 14 | E. N. Smith | 78 | 143 | 2.39 | 3.10 | 342 |
| June 28 | .....do | 74 | 99 | 1.10 | 2.60 | 112 |
| July 18 | Yates and Smith | 67 | 73 | .49 | 2.30 | 36 |
| July 28 | Smith and Sawyer | 67 | 82 | .41 | 2.21 | 34 |
| August 4 | E. N. Smith | 16 | 9.8 | 1.60 | 2.18 | 16 |
| August 12[a] | .....do | 14 | 8.2 | 1.16 | 2.12 | 10 |
| September 2 | .....do | 16 | 9.3 | 1.50 | 2.12 | 14 |
| October 12[b] | Sawyer and Hall | 38 | 23 | 2.78 | 2.38 | 64 |
| November 6 | R. S. Hall | 73 | 98 | 1.23 | 2.58 | 120 |

[a] One-half mile above bridge.

[b] About 300 feet above bridge.

*Daily gage height, in feet, of Malheur River at Vale, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 5.4 | 4.4 | 6.4 | 5.5 | 4.2 | 4.45 | 3.7 | 3.54 | 3.76 | 4.07 | 4.26 | 4.28 |
| 19 | 5.05 | 4.35 | 6.45 | 5.6 | 4.2 | 4.65 | 3.75 | 3.55 | 3.78 | 4.06 | 4.2 | 4.3 |
| 20 | 5.4 | 4.5 | 6.45 | 5.5 | 4.2 | 4.4 | 3.75 | 3.58 | 3.79 | 4.1 | 4.24 | 4.36 |
| 21 | 5.35 | 4.6 | 6.8 | 5.5 | 4.2 | 4.32 | 3.7 | 3.58 | 3.8 | 4.12 | 4.24 | 4.47 |
| 22 | 5.15 | 5.95 | 6.8 | 5.5 | 4.2 | 4.25 | 3.7 | 3.59 | 3.8 | 4.1 | 4.22 | 4.82 |
| 23 | 5.6 | 6.3 | 6.55 | 5.43 | 4.17 | 4.2 | 3.65 | 3.59 | 3.82 | 4.08 | 4.18 | 4.72 |
| 24 | 7.95 | 6.95 | 6.45 | 5.42 | 4.15 | 4.15 | 3.65 | 3.6 | 3.84 | 4.1 | 4.08 | 4.3 |
| 25 | 6.92 | 7.25 | 6.35 | 5.4 | 4.15 | 4.15 | 3.65 | 3.61 | 3.82 | 4.12 | 4.18 | 4.42 |
| 26 | 6.17 | 7.1 | 6.22 | 5.35 | 4.15 | 4.15 | 3.62 | 3.59 | 3.82 | 4.1 | 4.26 | 4.31 |
| 27 | 5.74 | 6.85 | 6.08 | 5.28 | 4.25 | 4.1 | 3.6 | 3.57 | 3.83 | 4.13 | 4.31 | 4.27 |
| 28 | 5.5 | 6.55 | 6.12 | 5.3 | 4.6 | 4.5 | 3.6 | 3.58 | 3.84 | 4.14 | 4.34 | 4.64 |
| 29 | 5.35 | ....... | 6.05 | 5.32 | 4.58 | 4.0 | 3.6 | 3.57 | 3.82 | 4.18 | 4.33 | 4.5 |
| 30 | 5.15 | ....... | 5.98 | 5.23 | 4.9 | 4.3 | 3.62 | 3.58 | 3.83 | 4.14 | 4.34 | 4.34 |
| 31 | 5.0 | ....... | 5.9 | ....... | 4.65 | ....... | 3.63 | 3.57 | ....... | 4.14 | ....... | 4.31 |

**Note.**—Ice conditions during part of January and December.

*Daily discharge, in second-feet, of Malheur River at Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 132 | 386 | 1,524 | 1,088 | 452 | 239 | 88 | 20 | 14 | 44 | 109 | 140 |
| 2 | 258 | 318 | 1,673 | 1,168 | 436 | 247 | 98 | 22 | 15 | 46 | 90 | 118 |
| 3 | 204 | 318 | 1,725 | 1,382 | 436 | 214 | 98 | 18 | 16 | 50 | 94 | 142 |
| 4 | 277 | 318 | 1,673 | 1,524 | 372 | 239 | 78 | 18 | 18 | 54 | 98 | 182 |
| 5 | 239 | 277 | 1,778 | 1,338 | 349 | 340 | 78 | 15 | 18 | 54 | 100 | 176 |
| 6 | 204 | 277 | 1,572 | 1,065 | 331 | 298 | 78 | 18 | 18 | 57 | 111 | 159 |
| 7 | 204 | 277 | 1,778 | 1,013 | 285 | 318 | 60 | 17 | 18 | 57 | 107 | 165 |
| 8 | 204 | 258 | 1,725 | 1,276 | 277 | 490 | 60 | 14 | 20 | 54 | 111 | 173 |
| 9 | 145 | 239 | 1,426 | 1,293 | 250 | 462 | 40 | 12 | 22 | 54 | 113 | 88 |
| 10 | 98 | 239 | 1,382 | 1,151 | 239 | 446 | 34 | 17 | 22 | 57 | 111 | 162 |
| 11 | 109 | 222 | 1,475 | 1,143 | 211 | 462 | 30 | 14 | 25 | 54 | 120 | 148 |
| 12 | 109 | 239 | 1,887 | 1,050 | 204 | 396 | 24 | 17 | 28 | 60 | 111 | 60 |
| 13 | 109 | 159 | 2,237 | 940 | 204 | 340 | 20 | 16 | 28 | 60 | 116 | 43 |
| 14 | 132 | 204 | 2,486 | 940 | 204 | 277 | 18 | 12 | 29 | 60 | 100 | 64 |
| 15 | 88 | 239 | 2,298 | 890 | 188 | 250 | 18 | 12 | 28 | 60 | 118 | 130 |
| 16 | 120 | 258 | 1,778 | 814 | 173 | 211 | 28 | 7 | 29 | 74 | 120 | 109 |
| 17 | 188 | 222 | 1,622 | 733 | 153 | 204 | 26 | 12 | 34 | 80 | 122 | 120 |
| 18 | 575 | 188 | 1,524 | 700 | 120 | 188 | 30 | 12 | 38 | 92 | 135 | 140 |
| 19 | 386 | 173 | 1,572 | 766 | 120 | 258 | 37 | 13 | 41 | 90 | 120 | 145 |
| 20 | 575 | 222 | 1,524 | 700 | 120 | 173 | 37 | 16 | 43 | 98 | 130 | 162 |
| 21 | 546 | 239 | 1,832 | 700 | 120 | 151 | 30 | 16 | 44 | 102 | 130 | 195 |
| 22 | 436 | 1,013 | 1,778 | 700 | 132 | 132 | 30 | 17 | 44 | 98 | 125 | 327 |
| 23 | 706 | 1,293 | 1,524 | 624 | 125 | 120 | 24 | 17 | 47 | 94 | 116 | 285 |
| 24 | 3,098 | 2,058 | 1,475 | 618 | 120 | 109 | 24 | 18 | 50 | 98 | 94 | 145 |
| 25 | 1,800 | 2,423 | 1,428 | 605 | 120 | 109 | 24 | 19 | 47 | 102 | 116 | 179 |
| 26 | 1,168 | 2,237 | 1,355 | 575 | 120 | 109 | 20 | 17 | 47 | 98 | 135 | 148 |
| 27 | 911 | 2,000 | 1,281 | 534 | 159 | 98 | 18 | 15 | 50 | 105 | 148 | 138 |
| 28 | 800 | 1,673 | 1,225 | 546 | 277 | 204 | 18 | 16 | 50 | 107 | 156 | 254 |
| 29 | 700 | ....... | 1,250 | 558 | 269 | 88 | 18 | 15 | 47 | 116 | 153 | 204 |
| 30 | 575 | ....... | 1,192 | 506 | 410 | 159 | 20 | 16 | 48 | 107 | 156 | 156 |
| 31 | 490 | ....... | 1,088 | ....... | 298 | ....... | 22 | 15 | ....... | 107 | ....... | 148 |

**Note.**—Owing to changeable bed the daily discharge has been obtained indirectly.

*Estimated monthly discharge of Malheur River at Vale, Oreg., for 1905.*

[Drainage area, 4,190 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 3,098 | 88 | 503 | 30,930 | 0.120 | 0.138 |
| February | 2,423 | 159 | 642 | 35,660 | .153 | .159 |
| March | 2,486 | 1,088 | 1,616 | 99,360 | .386 | .445 |
| April | 1,524 | 506 | 898 | 53,440 | .214 | .239 |
| May | 452 | 120 | 235 | 14,450 | .056 | .065 |
| June | 490 | 88 | 244 | 14,520 | .058 | .065 |
| July | 98 | 18 | 39.6 | 2,435 | .0095 | .011 |
| August | 22 | 7 | 15.6 | 959 | .0037 | .0043 |
| September | 50 | 14 | 32.6 | 1,940 | .0078 | .0087 |
| October | 116 | 44 | 77.1 | 4,741 | .018 | .021 |
| November | 156 | 90 | 119 | 7,081 | .028 | .031 |
| December | 327 | 43 | 155 | 9,531 | .037 | .043 |
| The year | 3,098 | 7 | 381 | 275,000 | .098 | 1.23 |

NOTE.—Estimates during January and December may be slightly large owing to ice conditions.

### MALHEUR RIVER AT M'LAUGHLIN'S BRIDGE, NEAR VALE, OREG.

This station was established December 10, 1904, by W. C. Sawyer. It is located at the new county bridge, known as McLaughlin's bridge, 10 miles above Vale, Oreg.

Discharge measurements are made from the iron bridge to which the gage is fastened, consisting of two spans and wooden approaches.

A standard chain gage is attached to the upstream hand rail of the bridge, near the left bank; length of the chain, 21.72 feet. In 1905 the gage was read weekly during a portion of January and February and daily during the remainder of the year by R. N. Linebarger.

A description of this station is contained in Water-Supply Paper No. 135, United States Geological Survey, page 109.

*Discharge measurements of Malheur River at McLaughlin's bridge, near Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 28 | Smith and Johnson | 84 | 160 | 4.56 | 3.80 | 730 |
| February 27 | do | 110 | 310 | 4.87 | 4.70 | 1,510 |
| March 2 | Griffin and Johnson | 98 | 290 | 4.55 | 4.50 | 1,320 |
| March 12 | E. N. Smith | 112 | 355 | 4.93 | 5.00 | 1,750 |
| March 14 | do | 153 | 409 | 5.21 | 5.41 | 2,133 |
| April 1 | Smith and Griffin | 96 | 223 | 4.35 | 4.00 | 970 |
| April 17 | J. M. Griffin | 90 | 260 | 3.43 | 3.90 | 890 |
| April 30 | do | 112 | 127 | 3.76 | 3.60 | 478 |
| May 6 | do | 79 | 138 | 3.15 | 3.35 | 434 |
| May 16 | do | 76 | 128 | 2.30 | 3.00 | 294 |
| June 14 | E. N. Smith | 78 | 143 | 2.39 | 3.10 | 342 |
| June 28 | do | 74 | 99 | 1.10 | 2.60 | 112 |
| July 18 | Yates and Smith | 67 | 73 | .49 | 2.30 | 36 |
| July 28 | Smith and Sawyer | 67 | 82 | .41 | 2.21 | 34 |
| August 4 | E. N. Smith | 16 | 9.8 | 1.60 | 2.18 | 16 |
| August 12[a] | do | 14 | 8.2 | 1.16 | 2.12 | 10 |
| September 2 | do | 16 | 9.3 | 1.50 | 2.12 | 14 |
| October 12[b] | Sawyer and Hall | 38 | 23 | 2.78 | 2.38 | 64 |
| November 6 | R. S. Hall | 73 | 98 | 1.23 | 2.58 | 120 |

[a] One-half mile above bridge.

[b] About 300 feet above bridge.

*Daily gage height, in feet, of Malheur River at McLaughlin's bridge, near Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.0 | 3.2 | 4.6 | 4.0 | 3.45 | 2.93 | 2.6 | 2.2 | 2.12 | 2.4 | 2.6 | 3.0 |
| 2 | 3.0 | 3.1 | 4.56 | 4.07 | 3.5 | 2.95 | 2.5 | 2.18 | 2.12 | 2.4 | 2.6 | 2.9 |
| 3 | 3.0 | 3.1 | 4.59 | 4.45 | 3.5 | 2.9 | 2.5 | 2.2 | 2.15 | 2.4 | 2.6 | 2.8 |
| 4 | 3.0 | 3.05 | 4.66 | 4.6 | 3.45 | 3.0 | 2.48 | 2.18 | 2.15 | 2.4 | 2.6 | 2.8 |
| 5 | 3.0 | 3.0 | 4.65 | 4.27 | 3.4 | 3.1 | 2.45 | 2.15 | 2.15 | 2.4 | 2.6 | 2.75 |
| 6 | 2.97 | 3.0 | 4.62 | 4.1 | 3.3 | 3.1 | 2.43 | 2.15 | 2.15 | 2.4 | 2.6 | 2.65 |
| 7 | 3.0 | 2.9 | 4.8 | 7.1 | 3.2 | 3.25 | 2.4 | 2.15 | 2.18 | 2.4 | 2.6 | 2.65 |
| 8 | 3.0 | 2.9 | 4.7 | 4.15 | 3.1 | 3.7 | 2.4 | 2.12 | 2.18 | 2.4 | 2.6 | 2.7 |
| 9 | 3.05 | 2.9 | 4.55 | 4.27 | 3.05 | 3.3 | 2.4 | 2.15 | 2.2 | 2.4 | 2.6 | 2.7 |
| 10 | 3.05 | 2.9 | 4.65 | 4.25 | 3.05 | 3.4 | 2.33 | 2.15 | 2.22 | 2.4 | 2.6 | 2.7 |
| 11 | 3.1 | 3.25 | 4.7 | 4.25 | 3.0 | 3.3 | 2.25 | 2.13 | 2.22 | 2.4 | 2.6 | 2.75 |
| 12 | 3.1 | 3.4 | 5.0 | 4.15 | 3.07 | 3.27 | 2.2 | 2.15 | 2.22 | 2.4 | 2.6 | 2.9 |
| 13 | 3.1 | 3.5 | 5.42 | 4.0 | 3.0 | 3.05 | 2.25 | 2.15 | 2.22 | 2.38 | 2.6 | 2.95 |
| 14 | 3.15 | 3.4 | 5.45 | 4.0 | 2.9 | 3.07 | 2.25 | 2.1 | 2.24 | 2.4 | 2.6 | 3.0 |
| 15 | 3.4 | 3.3 | 5.2 | 4.0 | 2.9 | 3.0 | 2.35 | 2.15 | 2.25 | 2.45 | 2.6 | 3.0 |
| 16 | 3.65 | 3.2 | 4.8 | 3.92 | 2.85 | 2.95 | 2.35 | 2.1 | 2.25 | 2.48 | 2.6 | 3.0 |
| 17 | 3.9 | 3.1 | 4.6 | 3.85 | 2.82 | 2.9 | 2.35 | 2.1 | 2.28 | 2.5 | 2.6 | 3.0 |
| 18 | 4.15 | 3.05 | 4.52 | 3.85 | 2.8 | 2.85 | 2.33 | 2.1 | 2.3 | 2.52 | 2.6 | 3.0 |
| 19 | 4.4 | 3.4 | 4.5 | 3.8 | 2.75 | 2.85 | 2.3 | 2.12 | 2.3 | 2.52 | 2.65 | 3.0 |
| 20 | 4.65 | 4.0 | 4.5 | 3.8 | 2.73 | 2.83 | 2.27 | 2.12 | 2.32 | 2.55 | 2.62 | 3.0 |
| 21 | 4.85 | 4.4 | 5.0 | 3.87 | ....... | 2.75 | 2.25 | 2.12 | 2.35 | 2.57 | 2.62 | 3.0 |
| 22 | 4.75 | 4.88 | 4.85 | 3.8 | 2.7 | 2.7 | 2.23 | 2.14 | 2.35 | 2.57 | 2.62 | 3.0 |
| 23 | 5.5 | 4.22 | 4.5 | 3.75 | 2.7 | 2.67 | 2.2 | 2.13 | 2.35 | 2.57 | 2.62 | 3.0 |
| 24 | 6.6 | 5.18 | 4.5 | 3.75 | 2.7 | 2.65 | 2.2 | 2.13 | 2.35 | 2.58 | 2.6 | 3.0 |
| 25 | 5.0 | 5.35 | 4.4 | 3.7 | 2.7 | 2.65 | 2.2 | 2.14 | 2.35 | 2.6 | 2.6 | 3.0 |
| 26 | 4.45 | 5.3 | 4.2 | 3.7 | 2.9 | 2.6 | 2.2 | 2.14 | 2.4 | 2.6 | 2.5 | 3.0 |
| 27 | 4.05 | 4.85 | 4.15 | 3.75 | 2.75 | 2.6 | 2.25 | 2.14 | 2.4 | 2.6 | 2.5 | 3.0 |
| 28 | 3.8 | 4.65 | 4.25 | 3.75 | 3.3 | 2.6 | 2.2 | 2.15 | 2.4 | 2.6 | 2.5 | 3.0 |
| 29 | 3.6 | ....... | 4.1 | 3.72 | 2.95 | 2.6 | 2.2 | 2.12 | 2.4 | 2.6 | 2.6 | 3.0 |
| 30 | 3.5 | ....... | 4.05 | 3.6 | 2.98 | 2.6 | 2.19 | 2.12 | 2.4 | 2.6 | 2.6 | 3.0 |
| 31 | 3.3 | ....... | 4.0 | ....... | 3.0 | ....... | 2.18 | 2.12 | 2.6 | 2.6 | ....... | 3.0 |

NOTE.—Ice conditions during part of January and February and all of December. Gage heights to top of ice.

*Station rating table for Malheur River at McLaughlin's bridge, near Vale, Oreg., from March 1 to April 15 and May 16 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 2 | 3.20 | 396 | 4.40 | 1,259 | 5.50 | 2,220 |
| 2.10 | 11 | 3.30 | 455 | 4.50 | 1,340 | 5.60 | 2,319 |
| 2.20 | 24 | 3.40 | 516 | 4.60 | 1,423 | 5.70 | 2,422 |
| 2.30 | 42 | 3.50 | 580 | 4.70 | 1,507 | 5.80 | 2,528 |
| 2.40 | 64 | 3.60 | 648 | 4.80 | 1,593 | 5.90 | 2,634 |
| 2.50 | 90 | 3.70 | 717 | 4.90 | 1,679 | 6.00 | 2,740 |
| 2.60 | 122 | 3.80 | 789 | 5.00 | 1,766 | 6.20 | 2,953 |
| 2.70 | 159 | 3.90 | 864 | 5.10 | 1,854 | 6.40 | 3,170 |
| 2.80 | 200 | 4.00 | 940 | 5.20 | 1,942 | 6.60 | 3,392 |
| 2.90 | 243 | 4.10 | 1,018 | 5.30 | 2,032 | 6.80 | 3,622 |
| 3.00 | 290 | 4.20 | 1,098 | 5.40 | 2,125 | 7.00 | 3,860 |
| 3.10 | 341 | 4.30 | 1,178 | | | | |

The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1905. It is well defined between gage heights 2.1 feet and 5.4 feet.

NOTE.—On account of the shifting channel the rating table does not apply prior to March 1 and between April 16 and May 15. Estimates during those intervals were computed by the indirect method. In the computation missing gage heights were interpolated.

*Estimated monthly discharge of Malheur River at McLaughlin's bridge, near Vale, Oreg., for 1905.*

[Drainage area, 3,320 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 2,980 | 260 | 751 | 46,180 | 0.226 | 0.261 |
| February | 2,080 | 210 | 726 | 40,320 | .219 | .228 |
| March | 2,170 | 940 | 1,438 | 88,420 | .433 | .499 |
| April | 3,980 | 485 | 971 | 57,780 | .292 | .326 |
| May | 475 | 160 | 283 | 17,400 | .085 | .098 |
| June | 715 | 122 | 274 | 16,300 | .083 | .093 |
| July | 122 | 22 | 47.0 | 2,890 | .014 | .016 |
| August | 24 | 11 | 15.8 | 972 | .0048 | .0055 |
| September | 64 | 13 | 37.1 | 2,208 | .011 | .012 |
| October | 122 | 44 | 87.7 | 5,392 | .026 | .030 |
| November | 140 | 90 | 120 | 7,140 | .036 | .040 |
| December | 290 | 140 | 251 | 15,430 | .076 | .088 |
| The year | 3,980 | 11 | 417 | 300,400 | .126 | 1.696 |

## MALHEUR RIVER AT HALLIDAY'S BRIDGE, NEAR ONTARIO, OREG.

This station was established December 8, 1904, by W. C. Sawyer, and discontinued July 31, 1905. It is located at Halliday's bridge, 10 miles west of Ontario, on the road to Vale, and 5 miles below the mouth of Willow Creek.

The channel is straight for 800 feet above and below the station. The right bank is high and clean. The left bank is high and clean, but overflows during very high water. The bed of the stream is composed of sand and is free from vegetation and shifting. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the single-span 110-foot steel highway bridge supported upon steel caissons. The initial point for soundings is a point on the upstream side of the bridge, 20 feet outside of the center of the truss pin on the right bank.

A standard chain gage is attached to the upstream hand rail; length of chain, 23.7 feet. During 1905 the gage was read by T. W. Halliday. Bench marks were established as follows: (1) The south end of the bed plate upon which the south end of the upstream truss rests upon the concrete pier; elevation, 18.99 feet. (2) The north end of the bed plate upon which the north end of the upstream truss rests; elevation, 18.89 feet. Elevations refer to the datum of the gage.

*Discharge measurements of Malheur River at Halliday's bridge, near Ontario, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 25 | E. N. Smith | 93 | 595 | 2.75 | 5.16 | 1,636 |
| January 26 | Smith and Johnson | 93 | 550 | 2.74 | 4.96 | 1,507 |
| January 30 | Sawyer and Griffin | 94 | 354 | 1.30 | 3.60 | 460 |
| February 24 | J. M. Griffin | 85 | 549 | 3.75 | 5.55 | 2,060 |
| March 1 | do | 92 | 532 | 2.77 | 4.80 | 1,475 |
| March 25 | W. C. Sawyer | 94 | 516 | 2.70 | 4.74 | 1,393 |
| March 27 | do | 94 | 448 | 2.45 | 4.41 | 1,098 |
| April 11 | Smith and Griffin | 95 | 421 | 2.41 | 4.36 | 1,014 |
| May 3 | do | 94 | 281 | 1.54 | 3.20 | 432 |
| June 21 | E. N. Smith | 92 | 167 | .53 | 2.15 | 89 |
| November 10 | R. S. Hall | 92 | 170 | .65 | 2.20 | 110 |
| December 29 | do | 90 | 106 | .71 | 2.29 | 75 |

*Daily gage height, in feet, of Malheur River at Halliday's bridge, near Ontario, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. |
|---|---|---|---|---|---|---|---|
| 1 | 2.7 | 3.2 | 4.85 | 4.15 | 3.3 | 2.38 | 1.67 |
| 2 | 2.7 | 3.1 | 4.95 | 4.22 | 3.27 | 2.25 | 1.67 |
| 3 | 2.8 | 3.0 | 4.95 | 4.58 | 3.2 | 2.2 | 1.58 |
| 4 | 2.85 | 2.9 | 4.9 | 4.77 | 3.1 | 2.27 | 1.62 |
| 5 | 2.8 | 2.9 | 5.1 | 4.53 | 3.1 | 2.55 | 1.5 |
| 6 | 2.6 | 2.8 | 5.15 | 4.27 | 3.08 | 2.55 | 1.5 |
| 7 | 2.6 | 2.7 | 5.2 | 4.18 | 2.97 | 2.65 | 1.45 |
| 8 | 2.35 | 2.6 | 5.1 | 4.25 | 2.93 | 2.8 | 1.5 |
| 9 | 2.3 | 2.7 | 4.95 | 4.32 | 2.85 | 3.0 | 1.5 |
| 10 | 2.35 | 2.5 | 4.85 | 4.35 | 2.55 | 3.47 | 1.4 |
| 11 | 2.35 | 2.4 | 5.0 | 4.37 | 2.45 | 2.97 | 1.4 |
| 12 | 2.3 | 2.8 | 5.25 | 4.23 | 2.43 | 2.85 | 1.3 |
| 13 | 2.35 | 2.5 | 5.4 | 4.12 | 2.4 | 2.7 | 1.3 |
| 14 | 2.35 | 2.65 | ........ | 4.05 | 2.35 | 2.55 | 1.4 |
| 15 | 2.35 | 2.7 | ........ | 4.0 | 2.35 | 2.4 | 1.4 |
| 16 | 2.5 | 2.8 | 5.0 | 3.83 | 2.3 | 2.3 | 1.4 |
| 17 | 2.45 | 2.7 | 4.85 | 3.8 | 2.25 | 2.25 | 1.4 |
| 18 | 3.85 | 2.7 | 4.85 | 3.75 | 2.17 | 2.25 | 1.4 |
| 19 | 3.85 | 2.7 | 4.75 | 3.75 | 2.22 | 2.5 | 1.4 |
| 20 | 4.5 | 2.8 | 4.85 | 3.75 | 2.0 | 2.17 | 1.28 |
| 21 | 4.3 | 3.25 | 5.15 | 3.75 | 1.95 | 2.1 | 1.35 |
| 22 | 3.85 | 4.75 | 5.2 | 3.7 | 1.9 | 2.03 | 1.35 |
| 23 | 5.0 | 5.15 | 5.0 | 3.65 | 1.93 | 1.92 | 1.4 |
| 24 | 7.15 | 5.65 | 4.85 | 3.6 | 1.9 | 1.85 | 1.4 |
| 25 | 5.9 | 5.85 | 4.7 | 3.55 | 1.87 | 1.85 | 1.4 |
| 26 | 4.8 | 5.6 | 4.6 | 3.48 | 1.85 | 1.83 | 1.38 |
| 27 | 4.35 | 5.35 | 4.4 | 3.45 | 2.08 | 1.77 | 1.35 |
| 28 | 3.95 | 5.05 | 4.35 | 3.47 | 2.47 | 1.68 | 1.35 |
| 29 | 3.6 | ........ | 4.25 | 3.52 | 2.5 | 1.67 | 1.35 |
| 30 | 3.4 | ........ | 4.2 | 3.38 | 2.33 | 1.73 | 1.4 |
| 31 | 3.3 | ........ | 4.2 | ........ | 2.27 | ........ | 1.4 |

NOTE.—No ice record.

*Station rating table for Malheur River at Halliday's bridge, near Ontario, Oreg., from January 1 to July 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.40 | 9 | 2.40 | 145 | 3.40 | 481 | 4.40 | 1,098 |
| 1.50 | 17 | 2.50 | 170 | 3.50 | 525 | 4.50 | 1,174 |
| 1.60 | 26 | 2.60 | 197 | 3.60 | 575 | 4.60 | 1,252 |
| 1.70 | 36 | 2.70 | 226 | 3.70 | 630 | 4.70 | 1,332 |
| 1.80 | 47 | 2.80 | 257 | 3.80 | 689 | 4.80 | 1,413 |
| 1.90 | 59 | 2.90 | 290 | 3.90 | 752 | 4.90 | 1,495 |
| 2.00 | 72 | 3.00 | 325 | 4.00 | 817 | 5.00 | 1,578 |
| 2.10 | 87 | 3.10 | 361 | 4.10 | 885 | 5.20 | 1,748 |
| 2.20 | 104 | 3.20 | 399 | 4.20 | 954 | 5.40 | 1,925 |
| 2.30 | 123 | 3.30 | 439 | 4.30 | 1,025 | 5.60 | 2,110 |

The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1904-5. It is well defined between gage heights 1.3 feet and 5.5 feet. The table has been extended beyond these limits. Above gage height 5.5 feet the rating curve is a tangent, the difference being 95 per tenth.

*Estimated monthly discharge of Malheur River at Halliday's bridge, near Ontario, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 3,582 | 123 | 635 | 39,040 |
| February | 2,158 | 170 | 663 | 36,820 |
| March | 1,925 | 954 | 1,484 | 91,250 |
| April | 1,388 | 473 | 810 | 48,200 |
| May | 439 | 53 | 183 | 11,250 |
| June | 512 | 33 | 149 | 8,866 |
| July | 33 | 3 | 11.6 | 713 |
| The period | | | | 236,100 |

## DITCHES IN MALHEUR RIVER VALLEY, OREGON.

### VINES DITCH ABOVE VALE, OREG.

This ditch diverts water from the right bank of Malheur River about 1 mile above the mouth of Malheur Canyon and 14 miles above Vale.

The gage and measuring section was half a mile below the mouth of the canyon.

*Discharge measurements of Vines ditch above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 29 | M. W. Torkelson | 1.23 |
| September 23 | E. N. Smith | .60 |
| August 5 | M. W. Torkelson | .32 |
| 1905. | | |
| June 14 | E. N. Smith | 3.7 |
| June 28 | do | 1.3 |
| September 30 | Hawthorne and Griffin | 1.0 |
| October 12 | Hall and Sawyer | 1.7 |
| November 6 | R. S. Hall | .9 |

### MALHEUR FARMERS' CANAL ABOVE VALE, OREG.

This canal diverts water from the left bank of Malheur River one-fourth mile above the mouth of Malheur Canyon and about 13 miles above Vale.

The gage and measuring section was located a short distance below the waste gate.

*Discharge measurements of Malheur Farmers' canal above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 24 | Torkelson and Hawthorne | 54.0 |
| July 5 | M. W. Torkelson | 33.3 |
| July 27 | do | 16.6 |
| August 5 | do | 11.4 |
| September 23 | E. N. Smith | 5.0 |
| 1905. | | |
| May 5 | J. M. Griffin | 83.6 |
| May 16 | Smith and Griffin | 50.8 |
| June 27 | E. N. Smith | 17.4 |
| July 12 | do | 27.6 |
| September 30 | T. H. Hawthorne | 16.7 |
| November 6 | R. S. Hall | 10.5 |

### M'LAUGHLIN DITCH ABOVE VALE, OREG.

Water diverted from the right bank of Malheur River 1 mile below the mouth of Malheur Canyon, 12 miles above Vale, is divided one-fourth mile below the point of diversion, the left branch being the McLaughlin ditch and the right the "J. H."

The McLaughlin ditch was measured at the dividing flume.

The McLaughlin ditch was the only one above the Nevada ditch which carried water between July 15 and about September 25, the Nevada having established a prior right over all of the others.

*Discharge measurements of McLaughlin ditch above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 25 | M. W. Torkelson | 10.8 |
| July 6 | do | 10.2 |
| July 22 | do | 6.2 |
| August 25 | Sawyer and Smith | 2.1 |
| September 23 | E. N. Smith | 13.2 |
| 1905. | | |
| May 16 | Smith and Griffin | 19.2 |
| June 14 | E. N. Smith | 4.2 |
| June 28 | do | 8.7 |
| July 12 | do | 5.6 |
| July 28 | do | 7.1 |
| August 3 | do | 4.0 |
| August 12 | do | 2.7 |
| August 22 | do | 2.5 |
| September 2 | do | 1.5 |
| September 30 | do | .7 |
| October 12 | W. C. Sawyer | .5 |
| November 6 | R. S. Hall | .5 |

### "J. H." DITCH ABOVE VALE, OREG.

The gage and measuring section on the "J. H." ditch was located one-half mile below the point of diversion from the McLaughlin ditch.

*Discharge measurements of "J. H." ditch above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 25 | M. W. Torkelson | 8.3 |
| July 6 | do | 9.6 |
| July 22 | do | 8.7 |
| August 5 | do | 7.1 |
| 1905. | | |
| May 16 | Smith and Griffin | 7.7 |
| June 15 | E. N. Smith | 11.1 |
| June 28 | do | 6.4 |
| July 12 | do | .3 |
| September 2 | do | 1.0 |
| September 30 | Hawthorne and Griffin | .6 |
| October 12 | W. C. Sawyer | .8 |

### LINEBARGER DITCH ABOVE VALE, OREG.

The Linebarger ditch diverted water from the right bank of Malheur River 10 miles above Vale, Oreg., from May 1 to June 14, 1905. June 14, 1905, a discharge measurement made by E. N. Smith gave a discharge of 2.7 second-feet.

### GELLERMAN & FROHMAN DITCH ABOVE VALE, OREG.

This ditch diverts water from the left bank of Malheur River about 8 miles above Vale. The gage and measuring section were located at Ricker's ranch.

*Discharge measurements of Gellerman & Frohman ditch above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 25 | M. W. Torkelson | 13.5 |
| July 30 | do | 4.5 |
| September 23 | E. N. Smith | 1.6 |
| 1905. | | |
| May 5 | J. M. Griffin | 64.7 |
| May 15 | E. N. Smith | 70.7 |
| June 12 | do | 42.8 |
| June 27 | do | 25.6 |
| July 12 | do | 8.6 |
| October 12 | Sawyer and Hall | 1.1 |

### SAND HOLLOW DITCH ABOVE VALE, OREG.

This ditch diverts water from the right bank of Malheur River 6 miles above Vale. The gaging station was located at High's ranch.

*Discharge measurements of Sand Hollow ditch above Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| June 29 | M. W. Torkelson | 12.4 |
| July 30 | ....do | 5.6 |
| August 9 | ....do | 2.9 |
| September 23 | E. N. Smith | 6.0 |
| 1905. | | |
| May 17 | Smith and Griffin | 12.6 |
| June 16 | E. N. Smith | 6.4 |
| June 29 | ....do | 7.5 |
| July 13 | ....do | 3.3 |
| October 12 | Sawyer and Hall | 5.8 |
| November 16 | R. S. Hall | 6.1 |

### HOPE MILL DITCH AT VALE, OREG.

This ditch diverts water from the left bank of Malheur River 2 miles above Vale. Its water was formerly used by a mill one-half mile south of Vale and returned to the river. Gagings were made just above the Bully Creek crossing.

*Discharge measurements of Hope Mill ditch at Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| May 1 | J. M. Griffin | 12.3 |
| June 10 | E. N. Smith | 9.9 |
| June 27 | ....do | 8.2 |
| July 8 | ....do | .8 |
| October 12 | Sawyer and Hall | 5.2 |
| November 4 | R. S. Hall | 5.6 |

### NEVADA DITCH BELOW VALE, OREG.

This ditch diverts water from the right bank of Malheur River 1 mile below Vale. Measurements were made 1,000 feet below the head-gate.

*Discharge measurements of Nevada ditch below Vale, Oreg., in 1904 and 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| July 12 | M. W. Torkelson | 107.0 |
| July 20 | ....do | 64.1 |
| August 6 | Torkelson and Smith | 46.5 |
| August 23 | Sawyer and Smith | 43.0 |
| September 7 | E. N. Smith | 34.0 |
| September 8 | ....do | 18.2 |
| September 24 | ....do | 49.9 |

*Discharge measurements of Nevada ditch below Vale, Oreg., in 1904 and 1905*—Continued.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1905. | | *Second-feet.* |
| April 25 | Smith and Grffin | 48.7 |
| May 25 | W. C. Sawyer | 69.3 |
| June 7 | E. N. Smith | 99.9 |
| July 13 | do | 24.0 |
| July 21 | do | 34.7 |
| July 29 | do | 27.6 |
| August 4 | do | 22.5 |
| August 11 | do | 16.9 |
| August 17 | do | 13.7 |
| August 29 | Smith and Eno | 14.3 |
| September 16 | G. Stubblefield | 25.9 |
| September 24 | Hawthorne and Stubblefield | 37.5 |
| October 4 | Hawthorne and Griffin | 39.2 |
| October 10 | Hall and Hawthorne | 37.2 |

*Discharge measurements of wasteways of Nevada ditch in 1905.*

McGREGOR WASTEWAY BELOW VALE, OREG.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| May 18 | Smith and Griffin | 0.9 |
| June 21 | E. N. Smith | 24.3 |
| October 4 | R. S. Hall | 15.9 |
| October 14 | do | .3 |

COTTON WASTEWAY ABOVE ONTARIO, OREG.

| | | |
|---|---|---|
| May 10 | E. N. Smith | 41.3 |
| June 21 | do | 6.9 |
| October 4 | Hawthorne and Griffin | 1.2 |
| October 15 | R. S. Hall | .5 |

### BROSNAN DITCH NEAR ONTARIO, OREG.

This ditch diverts water from the left bank of Malheur River 3 miles west of Ontario.

*Discharge measurements of Brosnan ditch near Ontario, Oreg., in 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| June 7 | E. N. Smith | 0.4 |
| October 4 | Hawthorne and Griffin | 3.9 |

### BULLY CREEK ABOVE VALE, OREG.

This station was established January 27, 1905. It is near the location of the original station on Bully Creek, one-fourth mile below Warm Springs stage station, 15 miles above Vale, Oreg.

The channel is straight for 50 feet above and 300 feet below the station. The current is swift. The right bank is high, but composed of soft soil, and may wash away for 70 feet, until the hillside is reached. The left bank is high and rocky, but may overflow a road 11 feet wide until the vertical cliff is reached. The bed of the stream is composed of gravel and is shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the stream face of the bolt to which the cable is anchored at the left bank.

The gage is in two sections. The lower section, reading from 0 to 7.6 feet, is nailed in an inclined position to posts embedded in riprap on the left bank. The upper section is a vertical staff, reading from 7.6 feet to 11 feet, fastened to the cliff. During 1905 the gage was read once each day by F. O'Neill. Bench marks were established as follows:

(1) A cut on a shoulder of the cliff 11 feet upstream from the vertical portion of the gage; elevation, 9.08 feet. (2) A standard copper bolt cemented in the solid rock 2½ feet upstream from the gage on the hill side of the road; elevation, 7.61 feet. Elevations refer to the datum of the gage.

Information in regard to station formerly maintained near this point is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 428; 135, pp 211-212.
Discharge: 100, p 429; 135, p 212.
Gage height: 100, p 429; 135, p 213.

*Discharge measurements of Bully Creek above Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 30 | Smith and Johnson | 37 | 30 | 0.86 | 2.18 | 27 |
| February 22 | Smith and Griffin | 34 | 41 | 2.07 | 2.66 | 85 |
| February 23 | E. N. Smith | 34 | 38 | 1.82 | 2.58 | 69 |
| February 25 | do | 53 | 80 | 3.66 | 3.40 | 294 |
| March 9 | Smith and Griffin | 48 | 72 | 2.98 | 3.10 | 215 |
| April 20 | E. N. Smith | 29 | 29 | 1.14 | 2.35 | 33 |
| June 9 | do | 26 | 16 | .75 | 2.00 | 12.0 |
| June 26[a] | do | 10 | 4.7 | .94 | 1.88 | 4.4 |
| July 8 | do | 8.7 | 4.3 | .39 | 1.79 | 1.7 |
| August 8[b] | do | | | | 1.69 | .3 |
| December 30[c] | R. S. Hall | 12 | 7.8 | .78 | 2.17 | 6.1 |

[a] Made one-half mile above cable. [b] Weir measurement. [c] Ice.

*Daily gage height, in feet, of Bully Creek above Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2.12 | 3.3 | 2.96 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.76 | 1.8 | 1.9 |
| 2 | | 2.1 | 3.28 | 3.2 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.76 | 1.8 | 1.9 |
| 3 | | 2.1 | 3.3 | 3.0 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.76 | 1.8 | 1.9 |
| 4 | | 2.1 | 3.38 | 2.94 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.78 | 1.8 | 1.92 |
| 5 | | 2.1 | 3.62 | 2.94 | 2.0 | 2.0 | 1.9 | 1.7 | 1.64 | 1.78 | 1.82 | 1.94 |
| 6 | | 2.1 | 3.55 | 2.9 | 2.0 | 2.0 | 1.9 | 1.7 | 1.64 | 1.78 | 1.82 | 1.96 |
| 7 | | 2.6 | 3.45 | 2.8 | 2.0 | 2.0 | 1.86 | 1.7 | 1.64 | 1.78 | 1.84 | 1.96 |
| 8 | | 2.6 | 3.20 | 2.8 | 2.0 | 2.0 | 1.8 | 1.68 | 1.64 | 1.78 | 1.84 | 1.96 |
| 9 | | 2.6 | 3.1 | 2.75 | 2.0 | 2.0 | 1.8 | 1.68 | 1.64 | 1.78 | 1.84 | 1.98 |
| 10 | | 2.6 | 3.1 | 2.75 | 2.0 | 2.0 | 1.8 | 1.68 | 1.64 | 1.78 | 1.86 | 1.98 |
| 11 | | 2.6 | 3.1 | 2.7 | 2.0 | 2.0 | 1.8 | 1.68 | 1.64 | 1.8 | 1.88 | 2.0 |
| 12 | | 2.18 | 3.34 | 2.65 | 2.0 | 2.0 | 1.8 | 1.66 | 1.64 | 1.8 | 1.9 | 2.0 |

*Daily gage height, in feet, of Bully Creek above Vale, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | ....... | 2.3 | 3.3 | 2.6 | 2.0 | 2.0 | 1.8 | 1.66 | 1.6 | 1.8 | 1.9 | 2.0 |
| 14 | ....... | 2.2 | 3.3 | 2.6 | 2.0 | 2.0 | 1.8 | 1.66 | 1.6 | 1.8 | 1.9 | 2.02 |
| 15 | ....... | 2.2 | 3.1 | 2.6 | 2.0 | 2.0 | 1.8 | 1.64 | 1.6 | 1.8 | 1.9 | 2.02 |
| 16 | ....... | 2.3 | 2.98 | 2.56 | 2.0 | 2.0 | 1.8 | 1.64 | 1.68 | 1.8 | 1.9 | 2.02 |
| 17 | ....... | 2.42 | 2.98 | 2.5 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.04 |
| 18 | ....... | 2.22 | 3.0 | 2.46 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.04 |
| 19 | ....... | 2.2 | 3.0 | 2.4 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.04 |
| 20 | ....... | 2.2 | 3.1 | 2.35 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.06 |
| 21 | ....... | 2.45 | 3.56 | 2.26 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.06 |
| 22 | ....... | 2.7 | 3.26 | 2.22 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.08 |
| 23 | ....... | 2.7 | 3.12 | 2.22 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.08 |
| 24 | 2.36 | 3.4 | 3.2 | 2.2 | 2.0 | 2.0 | 1.8 | 1.64 | 1.7 | 1.8 | 1.9 | 2.08 |
| 25 | 2.32 | 3.4 | 3.0 | 2.18 | 2.0 | 2.0 | 1.7 | 1.64 | 1.72 | 1.8 | 1.9 | 2.1 |
| 26 | 2.21 | 3.44 | 3.0 | 2.1 | 2.0 | 2.0 | 1.7 | 1.64 | 1.72 | 1.8 | 1.9 | 2.1 |
| 27 | 2.18 | 3.4 | 2.94 | 2.04 | 2.0 | 2.0 | 1.7 | 1.64 | 1.72 | 1.8 | 1.9 | 2.12 |
| 28 | 2.23 | 3.2 | 2.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.74 | 1.8 | 1.9 | 2.14 |
| 29 | 2.19 | ....... | 2.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.74 | 1.8 | 1.9 | 2.16 |
| 30 | 2.18 | ....... | 2.9 | 2.0 | 2.0 | 2.0 | 1.7 | 1.64 | 1.74 | 1.8 | 1.9 | 2.18 |
| 31 | 2.14 | ....... | 2.95 | ....... | 2.0 | ....... | 1.7 | 1.64 | ....... | 1.8 | ....... | 2.18 |

*Station rating table for Bully Creek above Vale, Oreg., from January 24 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.60 | 0.0 | 2.20 | 24 | 2.80 | 120 | 3.30 | 261 |
| 1.70 | .3 | 2.30 | 32 | 2.90 | 146 | 3.40 | 292 |
| 1.80 | 2.0 | 2.40 | 41 | 3.00 | 174 | 3.50 | 324 |
| 1.90 | 6.0 | 2.50 | 54 | 3.10 | 202 | 3.60 | 358 |
| 2.00 | 11 | 2.60 | 72 | 3.20 | 231 | 3.70 | 394 |
| 2.10 | 17 | 2.70 | 96 | | | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905. It is well defined between gage heights 1.7 feet and 3.4 feet.

*Estimated monthly discharge of Bully Creek above Vale, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January 24-31 | 37 | 19 | 26.5 | 421 |
| February | 305 | 17 | 84.5 | 4,693 |
| March | 365 | 146 | 224 | 13,770 |
| April | 231 | 11 | 77.1 | 4,588 |
| May | 11 | 11 | 11.0 | 676 |
| June | 11 | 11 | 11.0 | 655 |
| July | 11 | .3 | 3.11 | 191 |
| August | .3 | .1 | .17 | 10 |
| September | .9 | .1 | .30 | 18 |
| October | 2 | 1.2 | 1.83 | 112 |
| November | 6 | 2 | 4.93 | 293 |
| December | 6 | 6 | 6.00 | 369 |
| The year | 365 | .1 | 37.5 | 25,800 |

NOTE.—December estimate reduced on account of ice conditions.

## BULLY CREEK AT VALE, OREG.

This station was established April 8, 1904, by John H. Lewis, and discontinued December 31, 1905. It is located at the county highway bridge across Bully Creek just above its junction with Malheur River, at Vale, Oreg. The station is 13 miles below the former station on this creek, which was destroyed by flood and discontinued March 11, 1904. Except for a few days when the surface snow is going off, no streams enter Bully Creek between this and the old station. Five small ditches divert water during the irrigation season. The station is affected by backwater from Malheur River.

The channel is straight for about 50 feet above and 300 feet below the station and the current is swift. Both banks are high, clear, and not subject to overflow. The bed of the stream is composed of clay and sand and is shifting. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the single-span bridge. The initial point for soundings is the south end of the east bridge railing.

A standard chain gage is attached to the bridge; length of chain, 17.22 feet. During 1905 the gage was read once each day by Isaac McCumsey and Z. G. Wilson. Bench marks were established as follows: (1) The top surface of the north projecting floor beam on the east side of the bridge; elevation, 15.36 feet. (2) On the north end of stone doorsill at the north door on the west side of old flour mill about 390 feet southeast of the bridge; elevation, 18.80 feet. Elevations refer to the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 213–215.

*Discharge measurements of Bully Creek at Vale, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 25 | E. N. Smith | 40 | 18.9 | 0.86 | 3.70 | 16.1 |
| February 1 | P. H. Johnson | 40 | 18.5 | 1.13 | 3.70 | 20.9 |
| February 11 | J. M. Griffin | 40 | 12 | .82 | 3.60 | 9.9 |
| February 23 | Griffin and Smith | 42 | 43 | 1.72 | 4.32 | 74 |
| February 25 | J. M. Griffin | 42 | 114 | 3.91 | 5.95 | 447 |
| March 2 | E. N. Smith | 48 | 105 | 4.09 | 5.43 | 429 |
| March 3 | P. H. Johnson | 49 | 116 | 4.45 | 5.63 | 516 |
| March 9 | J. M. Griffin | 32 | 45 | 3.22 | 4.80 | 145 |
| March 23 | Smith and Johnson | 46 | 86 | 3.48 | 4.98 | 299 |
| March 30 | J. M. Griffin | 43 | 58 | 2.55 | 4.40 | 146 |
| April 11 | do | 40 | 34 | 2.68 | 3.95 | 91 |
| April 27 | do | 26 | 10.6 | 2.23 | 3.29 | 23.7 |
| June 10 | E. N. Smith | 31 | 25 | 3.00 | 3.75 | 75 |
| June 27[a] | do | 18 | 17.8 | 1.50 | 3.48 | 26.7 |
| July 29 | do | 11 | 5.7 | .82 | 3.05 | 4.7 |
| September 11 | W. C. Sawyer | 6 | 2.9 | .62 | 3.05 | 1.8 |
| October 12 | Sawyer and Hall | 10 | 2.7 | .79 | 3.05 | 2.1 |
| November 7[a] | R. S. Hall | 17 | 8.5 | .88 | 3.26 | 7.6 |
| December 27 | do | 14 | 6.2 | 1.09 | 3.17 | 6.8 |

[a] Made at different section.

*Daily gage height, in feet, of Bully Creek at Vale, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 3.7 | 5.3 | 4.3 | 3.3 | 3.4 | 3.3 | 3.1 | 3.02 | 3.05 | 3.05 | 3.35 |
| 2 | 3.6 | 3.7 | 5.5 | 4.6 | 3.25 | 3.4 | 3.3 | 3.1 | 3.03 | 3.06 | 3.05 | 3.4 |
| 3 | 3.6 | 3.7 | 5.5 | 4.6 | 3.3 | 3.4 | 3.3 | 3.1 | 3.03 | 3.04 | 3.21 | 3.49 |
| 4 | 3.5 | 3.7 | 6.7 | 4.4 | 3.3 | 3.4 | 3.3 | 3.0 | 3.03 | 3.04 | 3.25 | 3.41 |
| 5 | 3.5 | 3.7 | 5.4 | 4.3 | 3.25 | 3.6 | 3.3 | 3.0 | 3.03 | 3.03 | 3.23 | 3.5 |
| 6 | 3.5 | 3.6 | 5.7 | 4.2 | 3.3 | 3.6 | 3.3 | 3.0 | 3.05 | 3.03 | 3.21 | 3.32 |
| 7 | 3.5 | 3.6 | 5.45 | 4.15 | 3.25 | 3.75 | 3.3 | 3.0 | 3.04 | 3.04 | 3.31 | 3.55 |
| 8 | 3.5 | 3.4 | 4.95 | 4.1 | 3.2 | 3.8 | 3.3 | 3.02 | 3.03 | 3.04 | 3.21 | 3.45 |
| 9 | 3.5 | 3.6 | 4.75 | 4.0 | 3.2 | 3.8 | 3.3 | 3.01 | 3.03 | 3.04 | 3.16 | 3.35 |
| 10 | 3.5 | 3.6 | 4.6 | 4.0 | 3.25 | 3.75 | 3.3 | 3.0 | 3.03 | 3.06 | 3.1 | 3.45 |
| 11 | 3.5 | 3.6 | 4.6 | 3.95 | 3.25 | 3.7 | 3.2 | 3.01 | 3.03 | 3.04 | 3.1 | 3.25 |
| 12 | 3.5 | 3.5 | 4.9 | 3.9 | 3.25 | 3.65 | 3.25 | 3.01 | 3.04 | 3.05 | 3.1 | 3.2 |
| 13 | 3.5 | 3.5 | 5.1 | 4.0 | 3.3 | 3.6 | 3.25 | 3.01 | 3.03 | 3.04 | 3.09 | 3.2 |
| 14 | 3.3 | 3.7 | 5.0 | 3.75 | 3.3 | 3.8 | 3.2 | 3.01 | 3.04 | 3.05 | 3.61 | 3.12 |
| 15 | 3.4 | 3.7 | 4.8 | 3.6 | 3.3 | 3.85 | 3.2 | 3.0 | 3.02 | 3.04 | 3.11 | 3.12 |
| 16 | 3.4 | 3.5 | 4.7 | 3.6 | 3.3 | 3.65 | 3.2 | 3.01 | 3.04 | 3.05 | 3.09 | 3.2 |
| 17 | 3.5 | 3.6 | 4.6 | 3.5 | 3.3 | 3.65 | 3.2 | 3.0 | 3.03 | 3.06 | 3.1 | 3.17 |
| 18 | 3.5 | 3.6 | 4.5 | 3.45 | 3.3 | 3.65 | 3.2 | 3.0 | 3.04 | 3.06 | 3.06 | 3.2 |
| 19 | 3.5 | 3.5 | 4.5 | 3.4 | 3.3 | 3.7 | 3.2 | 3.0 | 3.04 | 3.05 | 3.19 | 3.23 |
| 20 | 3.5 | 3.5 | 4.4 | 3.4 | 3.3 | 3.6 | 3.2 | 3.0 | 3.04 | 3.05 | 3.23 | 3.45 |
| 21 | 3.5 | 3.7 | 5.1 | 3.3 | 3.3 | 3.6 | 3.2 | 3.01 | 3.04 | 3.04 | 3.2 | 3.32 |
| 22 | 3.5 | 3.95 | 5.0 | 3.3 | 3.3 | 3.7 | 3.15 | 3.0 | 3.04 | 3.06 | 3.25 | 3.17 |
| 23 | 3.6 | 4.45 | 5.1 | 3.25 | 3.3 | 3.6 | 3.15 | 3.0 | 3.06 | 3.06 | 3.28 | 3.3 |
| 24 | 4.2 | 5.4 | 4.8 | 3.25 | 3.3 | 3.6 | 3.1 | 3.01 | 3.06 | 3.08 | 3.16 | 3.2 |
| 25 | 3.7 | 5.75 | 4.8 | 3.25 | 3.3 | 3.6 | 3.1 | 3.01 | 3.07 | 3.08 | 3.19 | 3.29 |
| 26 | 3.8 | 5.55 | 4.5 | 3.3 | 3.3 | 3.6 | 3.1 | 3.0 | 3.08 | 3.08 | 3.42 | 3.2 |
| 27 | 3.8 | 5.6 | 4.6 | 3.25 | 3.3 | 3.5 | 3.1 | 3.01 | 3.08 | 3.06 | 3.47 | 3.2 |
| 28 | 3.8 | 5.4 | 4.4 | 3.3 | 3.45 | 3.4 | 3.1 | 3.02 | 3.04 | 3.05 | 3.32 | 3.16 |
| 29 | 3.8 | ....... | 4.4 | 3.3 | 3.45 | 3.4 | 3.1 | 3.01 | 3.04 | 3.03 | 3.34 | 3.19 |
| 30 | 3.65 | ....... | 4.4 | 3.3 | 3.4 | 3.35 | 3.1 | 3.02 | 3.03 | 3.06 | 3.36 | 3.17 |
| 31 | 3.65 | ....... | 4.4 | ....... | 3.4 | ....... | 3.0 | 3.02 | ....... | 3.03 | ....... | 3.14 |

NOTE.—No ice record.

## WILLOW CREEK NEAR MALHEUR, OREG.

This station was established November 4, 1904, by W. C. Sawyer. It is located at Beer's ranch, about 5 miles from Malheur, on the road to Huntington, Oreg.

The channel is straight for 100 feet above and below the station, and the current is swift. Both banks are high, clean, and do not overflow. The bed of the stream is composed of rock and gravel and is free from vegetation, and permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the eyebolt to which the cable is attached at the left bank.

A staff gage is attached to an immense bowlder at the mouth of the canyon, about one-half mile below the cable. During 1905 the gage was read once each day by S. P. Colt. The bench mark is a square chisel draft, marked with the letters "B. M." in black paint, on the top of the bowlder to which the gage is fastened, 5.4 feet upstream from the gage; elevation, 5.74 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 215–216.

*Discharge measurements of Willow Creek near Malheur, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet* |
| March 2[a] | W. C. Sawyer | 16 | 18.7 | 1.97 | 1.63 | 36.8 |
| March 2 | do | 15 | 15.0 | 2.61 | 1.52 | 37.6 |
| March 23 | do | 14 | 15.3 | 2.93 | 1.68 | 45.3 |
| September 14 | do | 8.2 | 4.5 | .93 | .65 | 4.2 |
| November 23 | R. S. Hall | 4.3 | 2.0 | .40 | .32 | .8 |

[a] Made by wading.

*Daily gage height, in feet, of Willow Creek near Malheur, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.0 | 1.25 | 1.54 | 0.96 | 0.56 | 0.85 | | | 0.8 | | |
| 2 | 1.0 | 1.0 | 1.52 | 1.64 | 1.0 | .78 | | | | .8 | | |
| 3 | | 1.0 | 1.6 | 1.6 | 1.12 | .82 | | | | .8 | | |
| 4 | | 1.0 | 1.5 | 1.52 | 1.12 | .94 | .55 | | | .8 | 0.5 | |
| 5 | | 1.0 | 1.7 | 1.48 | 1.06 | 1.0 | .5 | | | .8 | .5 | 0.5 |
| 6 | | 1.0 | 1.88 | 1.36 | 1.0 | 1.04 | .5 | | | .8 | .5 | .5 |
| 7 | | 1.2 | 2.1 | 1.32 | 1.0 | .94 | .5 | | | .8 | .5 | .5 |
| 8 | | 1.15 | 1.94 | 1.3 | | 1.14 | .5 | | | .85 | .5 | .5 |
| 9 | | 1.0 | 1.94 | 1.24 | | 1.0 | | | | .85 | .5 | .5 |
| 10 | | 1.05 | 1.96 | 1.26 | | .98 | | | | .9 | .5 | |
| 11 | | 1.3 | 1.86 | 1.26 | 1.1 | 1.0 | | | | .9 | .5 | |
| 12 | | 1.0 | 1.84 | 1.18 | 1.14 | 1.65 | | | | .9 | .5 | |
| 13 | | 1.1 | 1.8 | 1.06 | | 1.25 | | | | .9 | .45 | |
| 14 | | 1.2 | 1.66 | 1.0 | | 1.15 | | | | .9 | .45 | |
| 15 | 0.8 | 1.3 | 1.58 | .8 | | 1.1 | | | | .9 | .45 | |
| 16 | .85 | 1.2 | 1.5 | .78 | | 1.0 | | | | .9 | .45 | |
| 17 | .85 | 1.3 | 1.56 | .78 | | 1.0 | | | | .9 | .4 | |
| 18 | .9 | 1.4 | 1.9 | .82 | | .5 | | | | .9 | .4 | |
| 19 | .9 | 1.45 | 1.62 | 1.18 | .8 | .9 | | | | .8 | .4 | |
| 20 | .95 | 1.05 | 1.8 | 1.2 | .76 | .82 | | | | .8 | .4 | |
| 21 | 1.0 | | 1.66 | 1.06 | .76 | .84 | | | | .8 | .4 | |
| 22 | .95 | 1.45 | 1.74 | 1.06 | .76 | .66 | | | | .8 | .4 | |
| 23 | 1.0 | 1.45 | 1.64 | 1.0 | .9 | .52 | | | | .8 | .35 | |
| 24 | 1.05 | 1.2 | 1.58 | .86 | .74 | .54 | | | .8 | .8 | .35 | |
| 25 | 1.05 | 1.6 | 1.54 | .85 | .84 | | | | .8 | .8 | .35 | |
| 26 | 1.1 | 1.6 | 1.44 | .98 | .84 | | | | .8 | .8 | .35 | |
| 27 | 1.05 | 1.9 | 1.38 | .94 | .84 | .92 | | | .8 | .85 | .35 | |
| 28 | 1.1 | 1.7 | 1.36 | .82 | .8 | | | | .8 | .85 | | |
| 29 | 1.0 | | 1.5 | .86 | .82 | .6 | | | .8 | .85 | | |
| 30 | 1.15 | | 1.4 | .94 | | .65 | | | .8 | .85 | | |
| 31 | 1.0 | | 1.52 | | .96 | | | | | .85 | | |

NOTE.—Creek dry July 15 to August 24.

*Station rating table for Willow Creek near Malheur, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.30 | 0.5 | 0.80 | 7.0 | 1.30 | 24 | 1.80 | 53 |
| .40 | 1.2 | .90 | 9.5 | 1.40 | 29 | 1.90 | 61 |
| .50 | 2.2 | 1.00 | 12.5 | 1.50 | 34 | 2.00 | 69 |
| .60 | 3.5 | 1.10 | 16 | 1.60 | 40 | 2.10 | 78 |
| .70 | 5.0 | 1.20 | 20 | 1.70 | 46 | 2.20 | 87 |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is fairly well defined.

*Estimated monthly discharge of Willow Creek near Malheur, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January 15-31 | 18.0 | 7.0 | 12.2 | 410 |
| February | 61.0 | 12.5 | 23.4 | 1,300 |
| March | 78.0 | 22.0 | 44.5 | 2,736 |
| April | 42.5 | 6.5 | 18.3 | 1,089 |
| May | 17.5 | 6.0 | 11.1 | 682 |
| June | 43.0 | 2.0 | 10.5 | 625 |
| July | 8.2 | .0 | 1.4 | 86 |
| August | 2.0 | .0 | .45 | 28 |
| September | 7.0 | 2.0 | 4.7 | 280 |
| October | 9.5 | 7.0 | 8.0 | 492 |
| November 1-27 | 6.7 | .8 | 2.0 | 106 |
| The period | | | | 7,834 |

NOTE.—Water was taken from the creek above the gage by Beer's ditch from April 8 to July 3, July 15 to August 24, and September 8-12. The estimated amount diverted by the ditch is as follows:

| | Acre-feet. | | Acre-feet. |
|---|---|---|---|
| April 8-30 | 92 | July 1-3; 15-31 | 60 |
| May | 124 | August 1-24 | 58 |
| June | 120 | September 8-12 | 20 |

The estimate for Willow Creek does not include this diversion.

## WILLOW CREEK NEAR DELL, OREG.

This station was established May 12, 1904, by H. D. Newell. It is located at a bridge at Cole's ranch near Dell, Oreg., 28 miles above Vale.

Over two-thirds of the drainage area is practically free from timber. The river bottom is irrigated and cultivated and the higher lands are covered with sagebrush. The headwaters of the creek and its tributaries drain the southern slopes of the Burnt River Mountains, which are covered with stunted pines and junipers. The Eldorado mining ditch brings a small volume of water at irregular intervals into the creek from the headwaters of Burnt River. The flow of the creek is also affected by reservoirs used for mining purposes on some of its other tributaries.

The channel is slightly curved for about 200 feet above and straight for 200 feet below the station and is somewhat obstructed by willows. The current is moderate. Both banks are low, but all the water passes between the abutments of the bridge. The bed of the stream is composed of mud and is slightly shifting. There is but one channel at all stages, broken by the bridge bents.

Discharge measurements are made from the downstream side of the wooden highway bridge. The bridge has a single span of about 137 feet and trestle approach at each end. The initial point for soundings is the left end of the downstream hand rail.

A standard chain gage is attached to the downstream side of the bridge; length of chain, 18.06 feet. During 1905 the gage was read once each day by Emory Cole. Bench marks were established as follows: (1) A group of three spikes driven into a post at the corner of the fence about 40 feet east of the initial point; elevation, 14.92 feet. (2) A cross painted on the top of the stone of east abutment, 6.5 feet from the initial point and marked "B. M."; elevation, 14.79 feet. (3) The top of a bolt at the foot of the inclined end post of the south truss of the bridge, 20 feet from the initial point for soundings; elevation, 14.97 feet. Elevations refer to the datum of the gage.

A description of this station with gage heights, discharge data, and rating table is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 216–218.

*Discharge measurements of Willow Creek near Dell, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 31 | Smith and Johnson | 47 | 15 | 1.36 | 2.30 | 20.3 |
| March 3 | J. M. Griffin | 42 | 30 | 1.44 | 2.81 | 44 |
| March 4 | .....do | 43 | 38 | 1.54 | 3.00 | 58 |
| March 7 | Smith and Griffin | 53 | 54 | 1.81 | 3.50 | 98 |
| March 15 | Smith and Johnson | 52 | 51 | 1.83 | 3.55 | 93 |
| April 4 | Smith and Griffin | 41 | 13.2 | 1.75 | 2.68 | 23.1 |
| April 28 | .....do | 27 | 10.5 | 1.66 | 2.30 | 17.4 |
| June 3 | E. N. Smith | 24 | 6.0 | 1.67 | 2.10 | 11.0 |
| June 23 | .....do | 18 | 5.4 | 1.14 | 2.02 | 6.2 |
| July 11 | .....do | 5 | 1.3 | .20 | .......... | .2 |
| November 7 | R. S. Hall | 8 | 2.9 | .94 | 1.88 | 2.7 |

*Daily gage height, in feet, of Willow Creek near Dell, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | ....... | ....... | 3.1 | 2.5 | 2.75 | 2.2 | 1.8 | 1.65 | 2.0 | 2.0 | 2.0 |
| 2 | 2.7 | 2.3 | 3.4 | 3.2 | 2.6 | 2.7 | 2.2 | 1.8 | 1.65 | 2.05 | 2.0 | 2.0 |
| 3 | 2.7 | 2.3 | 2.8 | 2.9 | 2.75 | 2.7 | 2.2 | 1.8 | 1.65 | 2.05 | 2.0 | 2.1 |
| 4 | 2.8 | 2.4 | 2.95 | 2.75 | 2.5 | 2.6 | 2.3 | 1.7 | 1.65 | 2.0 | 1.9 | 2.1 |
| 5 | 2.7 | 2.3 | 3.4 | 2.6 | 2.6 | 2.5 | 2.3 | 1.7 | 1.65 | 2.0 | 1.9 | 2.1 |
| 6 | 2.8 | 2.4 | 3.5 | 2.5 | 2.6 | 2.5 | 2.2 | 1.8 | 1.65 | 2.0 | 2.0 | 2.1 |
| 7 | 2.75 | 2.4 | 3.4 | 2.6 | 2.7 | 2.55 | 2.1 | 1.8 | 1.65 | 2.0 | 2.0 | 2.1 |
| 8 | 2.75 | 2.4 | 3.5 | 2.7 | 2.8 | 2.5 | 2.1 | 1.7 | 1.65 | 2.1 | 2.0 | 2.1 |
| 9 | 2.75 | 2.4 | 3.4 | 2.75 | 2.75 | 2.45 | 2.0 | 1.7 | 1.65 | 2.1 | 2.0 | 2.2 |
| 10 | 2.8 | 2.4 | 3.5 | 2.75 | 2.7 | 2.4 | 2.0 | 1.7 | 1.65 | 2.0 | 2.0 | 2.2 |
| 11 | ....... | 2.5 | 3.3 | 2.75 | 2.7 | ....... | 1.9 | 1.7 | 1.65 | 2.0 | 2.1 | 2.3 |
| 12 | 2.8 | 2.5 | ....... | 2.7 | 2.6 | ....... | 1.8 | 1.7 | 1.65 | 2.0 | 2.0 | 2.2 |
| 13 | 2.8 | 2.8 | ....... | 2.7 | 2.7 | ....... | 1.8 | 1.7 | 1.65 | 2.0 | 2.0 | 2.2 |
| 14 | 2.8 | 3.0 | 3.8 | 2.7 | 2.8 | 2.5 | 1.8 | 1.7 | 1.65 | 2.0 | 2.0 | 2.4 |
| 15 | 3.2 | 3.0 | 4.2 | 2.5 | 2.6 | 2.5 | 1.8 | 1.7 | 1.65 | 2.0 | 2.1 | 2.4 |
| 16 | 3.2 | 3.0 | ....... | 2.5 | 2.7 | ....... | 1.8 | 1.7 | 1.65 | 2.1 | 2.1 | 2.3 |
| 17 | 3.2 | 2.85 | 3.3 | 2.4 | 2.7 | 2.5 | 1.8 | 1.65 | 1.65 | 2.1 | 2.0 | 2.3 |
| 18 | 3.2 | 3.0 | 3.2 | 2.4 | 2.7 | 2.55 | 1.7 | 1.65 | 1.65 | 2.15 | 2.1 | 2.3 |
| 19 | 3.3 | 3.0 | 3.2 | 2.4 | 2.7 | 2.6 | 1.8 | 1.65 | 1.65 | 2.15 | 2.1 | ...... |
| 20 | 3.3 | 3.0 | 3.2 | 2.3 | 2.8 | 2.5 | 1.8 | 1.65 | 1.65 | 2.1 | 2.1 | ...... |
| 21 | 3.4 | 3.0 | 3.3 | 2.4 | 2.8 | 2.4 | 1.8 | 1.65 | 1.85 | 2.1 | 2.0 | ...... |
| 22 | 3.4 | 3.3 | 3.4 | 2.4 | 2.7 | 2.4 | 1.7 | 1.65 | 1.85 | 2.1 | 2.0 | ...... |

*Daily gage height, in feet, of Willow Creek near Dell, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 3.3 | 3.85 | 3.2 | 2.3 | 2.7 | 2.3 | 1.7 | 1.65 | 1.85 | 2.1 | 2.0 | ...... |
| 24 | 3.3 | 3.4 | 3.2 | 2.2 | 2.75 | 2.3 | 1.7 | 1.65 | 1.9 | 2.1 | 1.9 | ...... |
| 25 | 3.3 | 3.4 | 3.2 | 2.3 | 2.7 | 2.3 | 1.8 | 1.65 | 2.0 | 2.1 | 2.0 | ...... |
| 26 | 3.4 | 3.4 | 3.2 | 2.3 | 2.8 | 2.3 | 1.7 | 1.65 | 2.0 | 1.9 | 2.1 | ...... |
| 27 | 3.4 | 3.6 | 3.2 | 2.4 | 2.7 | 2.3 | 1.7 | 1.65 | 2.05 | 1.9 | 2.1 | ...... |
| 28 | 3.4 | 3.5 | 3.3 | 2.5 | 2.75 | 2.2 | 1.8 | 1.65 | 2.0 | 2.1 | 2.1 | ...... |
| 29 | 3.0 | ...... | 3.3 | 2.5 | 3.0 | 2.2 | 1.8 | 1.65 | 2.05 | 1.9 | 2.0 | ...... |
| 30 | 2.7 | ...... | 3.2 | 2.4 | ...... | 2.3 | 1.7 | 1.65 | 1.95 | 2.0 | 2.1 | ...... |
| 31 | ...... | ...... | 3.2 | ...... | 2.8 | ...... | 1.7 | 1.65 | ...... | 2.0 | ...... | ...... |

NOTE.—No ice record.

*Station rating table for Willow Creek near Dell, Oreg., from January 1 to March 13 and April 6 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.70 | 0.5 | 2.30 | 18 | 2.90 | 51 | 3.50 | 98 |
| 1.80 | 1 | 2.40 | 22 | 3.00 | 58 | 3.60 | 107 |
| 1.90 | 3 | 2.50 | 27 | 3.10 | 65 | 3.70 | 116 |
| 2.00 | 6 | 2.60 | 33 | 3.20 | 73 | 3.80 | 126 |
| 2.10 | 10 | 2.70 | 39 | 3.30 | 81 | 3.90 | 136 |
| 2.20 | 14 | 2.80 | 45 | 3.40 | 89 | 4.00 | 146 |

The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905. It is well defined below gage height 5 feet. On account of a change in the channel, which lasted from March 14 to April 5, a supplementary rating table is required during that period.

*Station rating table for Willow Creek near Dell, Oreg., from March 14 to April 5, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.60 | 19 | 3.10 | 53 | 3.50 | 88 | 3.90 | 130 |
| 2.70 | 25 | 3.20 | 61 | 3.60 | 98 | 4.00 | 142 |
| 2.80 | 31 | 3.30 | 70 | 3.70 | 108 | 4.10 | 154 |
| 2.90 | 38 | 3.40 | 79 | 3.80 | 119 | 4.20 | 166 |
| 3.00 | 45 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on two discharge measurements made in March and April, 1905. It is fairly well defined.

*Estimated monthly discharge of Willow Creek near Dell, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 89 | 18 | 59.6 | 3,665 |
| February | 131 | 18 | 51.5 | 2,860 |
| March | 166 | 45 | 80.5 | 4,950 |
| April | 61 | 14 | 29.6 | 1,761 |
| May | 58 | 27 | 39.8 | 2,447 |
| June | 42 | 14 | 25.4 | 1,511 |
| July | 18 | .5 | 4.6 | 283 |
| August | 1 | .0 | .34 | 21 |
| September | 8 | .0 | 1.5 | 89 |
| October | 12 | 3 | 7.3 | 449 |
| November | 10 | 3 | 7.0 | 417 |
| The period | | | | 18,450 |

**Note.**—Discharge was interpolated for missing gage heights.

## DITCHES IN WILLOW CREEK VALLEY NEAR VALE, OREG.

The following measurements were made of ditches diverting water from Willow Creek below Cole's ranch, 28 miles above Vale:

*Discharge measurements of ditches in Willow Creek Valley above Vale, Oreg.*

COLE'S DITCH NEAR DELL.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| July 8 | M. W. Torkelson | 1.9 |
| August 3 | do | 1.4 |
| September 3 | E. N. Smith | 1.5 |
| 1905. | | |
| April 27 | Smith and Griffin | 7.0 |
| June 2 | E. N. Smith | 3.1 |
| July 10 | do | .7 |
| September 28 | J. M. Griffin | .5 |
| November 8 | R. S. Hall | .14 |

COMPANY DITCH.

| | | |
|---|---|---|
| 1904. | | |
| July 8 | M. W. Torkelson | 8.5 |
| August 3 | do | .3 |
| September 3 | E. N. Smith | 1.2 |
| 1905. | | |
| April 28 | Smith and Griffin | 15.4 |
| June 3 | E. N. Smith | 12.6 |
| June 23 | do | 8.1 |
| July 11 | do | .3 |
| September 28 | J. M. Griffin | 4.5 |

*Discharge measurements of ditches in Willow Creek Valley above Vale, Oreg.*—Continued.

### PATRICK FAULKNER DITCH.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| September 3 | E. N. Smith | 0.4 |
| 1905. | | |
| April 29 | Smith and Griffin | 1.5 |
| June 1 | E. N. Smith | 1.4 |
| July 11 | do | .76 |
| August 10 | do | .09 |

### LARRY FAULKNER DITCH.

| | | |
|---|---|---|
| 1905. | | |
| April 29 | Smith and Griffin | 3.3 |

### GRAY DITCH.

| | | |
|---|---|---|
| 1905. | | |
| August 9 | E. N. Smith | 4.1 |

### HARRIS DITCH.

| | | |
|---|---|---|
| 1905. | | |
| April 29 | Smith and Griffin | 0.5 |

### LOGAN DITCH.

| | | |
|---|---|---|
| 1904. | | |
| August 3 | M. W. Torkelson | 1.2 |
| 1905. | | |
| April 28 | E. N. Smith | 5.4 |
| June 2 | do | .22 |
| July 11 | do | .33 |
| September 28 | J. M. Griffin | .67 |

### BECKER CREEK LOGAN DITCH.

| | | |
|---|---|---|
| 1905. | | |
| April 28 | Smith and Griffin | 0.5 |

### NORWOOD DITCH.

| | | |
|---|---|---|
| 1905. | | |
| April 27 | Smith and Griffin | 2.5 |
| June 2 | E. N. Smith | .37 |
| June 23 | do | .3 |

### PETERSON AND TETER DITCH.

| | | |
|---|---|---|
| 1905. | | |
| April 29 | E. N. Smith | 3.1 |

*Discharge measurements of ditches in Willow Creek Valley above Vale, Oreg.*—Continued.

SCOTT DITCH.

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| 1904. | | *Second-feet.* |
| July 7 | M. W. Torkelson[a] | 1.9 |
| July 7 | do.[b] | 5.2 |
| 1905. | | |
| April 28 | Smith and Griffin[c] | 3.5 |
| June 2 | E. N. Smith[c] | 1.3 |
| June 23 | do.[c] | 1.6 |

TURNER DITCH.

| | | |
|---|---|---|
| 1904. | | |
| August 3 | M. W. Torkelson | 2.2 |
| September 3 | E. N. Smith | 1.8 |
| 1905. | | |
| April 28 | Smith and Griffin | 1.4 |
| June 3 | E. N. Smith | 3.1 |
| July 11 | do | .27 |
| June 23 | do | 1.2 |
| August 25 | do | .6 |

[a] Upper Scott ditch.
[b] Lower Scott ditch.
[c] Above diversion.

## POWDER RIVER NEAR BAKER CITY, OREG.

This station was established December 20, 1903, by John H. Lewis. It is located 10 miles above Baker City, Oreg., and one-fourth mile below Salisbury, a station on the Sumpter Valley Railway. The station is above all important diversions and above the point where the river enters the valley which surrounds Baker City. Above the station the river drains the eastern slope of a spur of the Blue Mountains. A large portion of the area has been cleared of timber.

The channel is straight for about 75 feet above and 100 feet below the station, and the current is swift. Both banks are low, timbered, and liable to overflow. The bed of the stream is composed of gravel and is free from vegetation and permanent. There is but one channel at all stages.

Discharge measurements are made from a wagon bridge having a single span of about 50 feet. The initial point for soundings is at the left end of the bridge.

A staff gage is fastened vertically to a tree on the left bank, about 400 feet below the house of R. M. Garrett, who during 1905 read the gage twice each day. The bench mark is a group of three 30-penny nails driven into a large cottonwood tree which stands on the left bank of the stream 35 feet below the gage and 6 feet above the end of the bridge; elevation, 8.00 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 430–431; 135, p 221.
Discharge: 100, p 431; 135, p 222.
Discharge, monthly: 135, p 223.
Gage heights: 100, p 431; 135, p 222.
Rating table: 135, p 223.

*Discharge measurements of Powder River near Baker City, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 28 | W. C. Sawyer | 40 | 54.0 | 2.78 | 2.94 | 151 |
| May 23 | do | 40 | 58.0 | 2.97 | 3.10 | 172 |
| August 1 | do | 25 | 15.1 | 1.00 | 1.91 | 15.3 |
| November 13[a] | R. S. Hall | 30 | 26.3 | .43 | 2.11 | 11.3 |

[a] River partly covered with ice.

*Daily gage height, in feet, of Powder River near Baker City, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.15 | 2.15 | 2.7 | 2.85 | 3.35 | 3.55 | 2.45 | 2.05 | 1.65 | 1.95 | 2.05 | 2.1 |
| 2 | 2.05 | 2.1 | 2.6 | 2.85 | 3.4 | 3.45 | 2.55 | 2.0 | 1.65 | 1.95 | 2.1 | 2.05 |
| 3 | 1.95 | 2.1 | 2.7 | 2.95 | 3.4 | 3.45 | 2.45 | 1.9 | 1.6 | 1.85 | 2.05 | 2.0 |
| 4 | 2.0 | 2.25 | 3.0 | 3.05 | 3.25 | 3.45 | 2.35 | 1.85 | 1.7 | 2.05 | 2.05 | 2.05 |
| 5 | 2.0 | 2.25 | 2.95 | 2.95 | 3.15 | 3.45 | 2.25 | 1.8 | 1.6 | 1.95 | 2.05 | 2.1 |
| 6 | 2.0 | 2.05 | 3.05 | 2.95 | 3.05 | 3.3 | 2.15 | 1.8 | 1.55 | 1.95 | 2.0 | 2.1 |
| 7 | 2.0 | 2.15 | 3.05 | 3.15 | 3.25 | 3.2 | 1.95 | 1.8 | 1.55 | 2.0 | 2.1 | 2.1 |
| 8 | 1.95 | 2.2 | 2.95 | 3.35 | 3.25 | 3.25 | 1.9 | 1.85 | 1.6 | 2.05 | 2.05 | 2.05 |
| 9 | 1.9 | 2.15 | 2.95 | 3.35 | 3.15 | 3.25 | 1.75 | 1.75 | 1.6 | 2.0 | 2.05 | 2.05 |
| 10 | 1.9 | 2.05 | 3.05 | 3,25 | 3.05 | 3.15 | 1.95 | 1.85 | 1.6 | 2.05 | 2.05 | 2.0 |
| 11 | 1.9 | 2.0 | 3.0 | 3.15 | 3.05 | 3.1 | 2.15 | 1.85 | 1.55 | 2.05 | 2.05 | 2.1 |
| 12 | 1.9 | 2.15 | 3.3 | 3.2 | 3.05 | 3.05 | 2.0 | 1.85 | 1.55 | 2.05 | 2.0 | 2.1 |
| 13 | 1.9 | 2.15 | 3.35 | 3.05 | 3.05 | 3.0 | 2.05 | 1.8 | 1.55 | 2.05 | 2.1 | 2.1 |
| 14 | 1.9 | 2.25 | 3.25 | 3.05 | 3.0 | 3.05 | 2.05 | 1.85 | 1.55 | 1.85 | 2.1 | 2.1 |
| 15 | 1.9 | 2.25 | 3.45 | 3.15 | 2.95 | 3.05 | 2.05 | 1.85 | 1.55 | 2.0 | 2.0 | 2.1 |
| 16 | 2.0 | 2.25 | 3.45 | 3.05 | 3.05 | 2.95 | 2.05 | 1.8 | 1.55 | 1.95 | 2.0 | 2.1 |
| 17 | 2.15 | 2.3 | 3.45 | 3.15 | 3.25 | 2.85 | 2.0 | 1.85 | 1.6 | 2.0 | 2.05 | 2.05 |
| 18 | 2.25 | 2.35 | 3.35 | 3.05 | 3.35 | 2.85 | 2.05 | 1.75 | 1.55 | 1.95 | 2.1 | 2.05 |
| 19 | 2.35 | 2.25 | 3.25 | 3.15 | 3.25 | 2.75 | 1.85 | 1.75 | 1.55 | 1.95 | 2.1 | 2.05 |
| 20 | 2.25 | 2.25 | 3.15 | 3.1 | 3.25 | 2.85 | 1.85 | 1.7 | 1.6 | 1.95 | 2.05 | 2.1 |
| 21 | 2.35 | 2.25 | 3.15 | 3.1 | 3.25 | 2.75 | 1.95 | 1.65 | 1.6 | 2.1 | 2.0 | 2.1 |
| 22 | 2.35 | 2.3 | 3.15 | 3.1 | 3.25 | 2.6 | 1.95 | 1.65 | 1.75 | 2.1 | 2.0 | 2.1 |
| 23 | 2.4 | 2.4 | 3.1 | 3.1 | 3.10 | 2.65 | 2.05 | 1.6 | 1.7 | 2.05 | 2.05 | 2.1 |
| 24 | 2.3 | 2.35 | 3.15 | 3.2 | 3.15 | 2.65 | 2.0 | 1.65 | 1.65 | 2.05 | 2.05 | 2.1 |
| 25 | 2.45 | 2.25 | 3.05 | 3.25 | 3.05 | 2.65 | 1.85 | 1.7 | 1.65 | 2.0 | 2.05 | 2.0 |
| 26 | 2.35 | 2.35 | 2.95 | 3.4 | 3.05 | 2.6 | 1.9 | 1.65 | 1.75 | 2.05 | 2.05 | 2.0 |
| 27 | 2.35 | 2.55 | 2.9 | 3.45 | 3.1 | 2.55 | 1.9 | 1.6 | 1.65 | 2.0 | 2.05 | 2.0 |
| 28 | 2.2 | 2.4 | 2.9 | 3.45 | 3.15 | 2.55 | 1.85 | 1.65 | 1.75 | 2.1 | 2.05 | 2.0 |
| 29 | 2.15 | ....... | 2.85 | 3.35 | 3.0 | 2.6 | 1.85 | 1.65 | 1.75 | 2.1 | 2.1 | 2.05 |
| 30 | 2.2 | ....... | 2.85 | 3.45 | 3.15 | 2.45 | 1.9 | 1.65 | 1.95 | 2.05 | 2.1 | 2.1 |
| 31 | 2.15 | ....... | 2.65 | ....... | 3.35 | ....... | 2.05 | 1.6 | ....... | 2.05 | ....... | 2.1 |

NOTE.—Ice conditions during January, February, November, and December. Gage heights are to water surface. They are only approximate owing to changing ice conditions.

*Station rating table for Powder River near Baker City, Oreg., from January 1, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 2 | 2.80 | 120 | 4.30 | 571 | 5.70 | 1,048 |
| 1.40 | 2.5 | 2.90 | 140 | 4.40 | 605 | 5.80 | 1,082 |
| 1.50 | 3 | 3.00 | 161 | 4.50 | 639 | 5.90 | 1,116 |
| 1.60 | 4 | 3.10 | 184 | 4.60 | 673 | 6.00 | 1,150 |
| 1.70 | 7 | 3.20 | 209 | 4.70 | 707 | 6.20 | 1,218 |
| 1.80 | 11 | 3.30 | 237 | 4.80 | 741 | 6.40 | 1,286 |
| 1.90 | 16 | 3.40 | 267 | 4.90 | 775 | 6.60 | 1,354 |
| 2.00 | 22 | 3.50 | 299 | 5.00 | 810 | 6.80 | 1,422 |
| 2.10 | 30 | 3.60 | 333 | 5.10 | 844 | 7.00 | 1,490 |
| 2.20 | 38 | 3.70 | 367 | 5.20 | 878 | 7.20 | 1,558 |
| 2.30 | 48 | 3.80 | 401 | 5.30 | 912 | 7.40 | 1,626 |
| 2.40 | 60 | 3.90 | 435 | 5.40 | 946 | 7.60 | 1,694 |
| 2.50 | 72 | 4.00 | 469 | 5.50 | 980 | 7.80 | 1,762 |
| 2.60 | 86 | 4.10 | 503 | 5.60 | 1,014 | 8.00 | 1,830 |
| 2.70 | 102 | 4.20 | 537 | | | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1903–1905. It is fairly well defined above gage height 1.7 feet.

*Estimated monthly discharge of Powder River near Baker City, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 283 | 86 | 179 | 11,010 |
| April | 283 | 130 | 201 | 11,960 |
| May | 267 | 150 | 202 | 12,420 |
| June | 316 | 66 | 164 | 9,759 |
| July | 79 | 9 | 27.0 | 1,660 |
| August | 26 | 4 | 10.0 | 615 |
| September | 19 | 3.5 | 5.4 | 321 |
| October | 30 | 13 | 23.1 | 1,420 |
| The period | | | | 49,160 |

NOTE.—Reliable estimates could not be prepared during January, February, November, and December on account of ice conditions.

## GRANDE RONDE RIVER AT HILGARD, OREG.

This station was established November 6, 1903, by John H. Lewis. It is located at the county highway bridge one-half mile below the Oregon Railroad and Navigation Company station at Hilgard, Oreg. It is just below the mouth of Five Points Creek, which is the first important tributary above Grande Ronde Valley. There are two dams about 20 miles upstream, used to flood the river during the log-driving season. The drainage area above this station lies almost wholly in the northern and eastern slopes of the Blue Mountains, the greater portion being well timbered.

The channel is straight for 100 feet above and 200 feet below the station. At ordinary stages all the water passes under the right span, which has a length of 70 feet from the right abutment to the middle pier. At high stages the water also passes under the shorter span, which has a length of 52 feet from the left abutment to the middle pier. The right bank is low, but is not liable to overflow. The left bank is low and will overflow only at a few points above the bridge. The bed of the stream is composed of sand and clay and is free from vegetation and bowlders. It is permanent under the main span, but is liable to shift in the high-water channel under the shorter span.

Discharge measurements are made from the downstream side of the two-span bridge, which is supported by two timber-crib abutments and by one middle crib pier. The initial point for soundings is at a point where the end post meets the lower chord of the bridge on the right bank. It is directly over the vertical outer edge of the abutment.

The gage is a staff driven vertically into the ground at the downstream end of the middle bridge pier and bolted at the upper end to the log pier. During 1905 the gage was read once daily at ordinary stages and twice daily during floods by Jay Hawes. Bench marks were established as follows: (1) The head of a bolt through the lower chord of the bridge, 7.5 feet from the timber to which the gage is attached; elevation, 13.80 feet. (2) A square chisel draft and the letters "U. S. B. M." cut in the top of a rock 200 feet from the right bank, 150 feet upstream from the bridge; elevation, 12.81 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 420; 135, p 224.
Discharge: 100, p 420; 135, p 225.
Discharge, monthly: 135, p 226.
Gage heights: 100, p 421; 135, p 225.
Rating table: 135, p 226.

*Discharge measurements of Grande Ronde River at Hilgard, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 4 | W. C. Sawyer | 69 | 260 | 1.91 | 3.95 | 498 |
| May 16 | .....do | 70 | 293 | 2.17 | 4.10 | 636 |
| August 2 [a] | .....do | 28 | 35 | 1.27 | 2.86 | 44.1 |
| November 14 | R. S. Hall | 67 | 188 | .26 | 2.86 | 48.9 |

[a] Made at different section.

*Daily gage height, in feet, of Grande Ronde River at Hilgard, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.0 | 3.1 | 3.8 | 3.95 | 4.3 | 3.8 | 2.2 | 2.85 | 2.65 | 2.7 | 2.85 | 2.8 |
| 2 | 3.0 | 3.1 | 4.0 | 3.92 | 4.1 | 3.9 | 2.3 | 2.85 | 2.6 | [a] 3.7 | 2.8 | 2.85 |
| 3 | 3.05 | 3.0 | 4.0 | 4.0 | 4.3 | 3.9 | 3.0 | 2.85 | 2.6 | 2.85 | 2.8 | 2.8 |
| 4 | 2.95 | 3.0 | 4.0 | 4.0 | 5.0 | 3.9 | 3.1 | 2.85 | 2.62 | 2.7 | 2.8 | 2.8 |
| 5 | 2.9 | 3.0 | 3.95 | 4.1 | 5.2 | 3.85 | 3.2 | 2.85 | 2.8 | 2.7 | [a] 3.8 | 2.75 |
| 6 | 2.9 | 3.0 | 3.92 | 4.1 | 5.3 | 3.75 | 3.1 | 2.85 | 2.7 | 2.7 | 2.8 | 2.75 |
| 7 | 2.9 | 3.05 | 3.9 | 4.15 | [a] 6.8 | 3.7 | 3.1 | 2.85 | 2.7 | 2.7 | 2.75 | 2.8 |
| 8 | 3.0 | 3.02 | 3.85 | 4.05 | 5.8 | 3.72 | 3.1 | 2.85 | 2.7 | 2.7 | 2.8 | 2.8 |
| 9 | 3.0 | 3.0 | 3.85 | 4.0 | 5.2 | 3.75 | 3.0 | 2.85 | 2.7 | 2.75 | 2.85 | 2.8 |
| 10 | 2.95 | 2.9 | 3.9 | 3.95 | 5.5 | 3.7 | 2.75 | 2.85 | 2.65 | 2.75 | 2.85 | 2.8 |
| 11 | 2.92 | 2.8 | 3.6 | 4.0 | [a] 6.2 | 3.7 | 2.75 | 2.85 | 2.65 | 2.75 | 2.85 | 2.85 |
| 12 | 2.85 | 3.1 | 3.6 | 4.1 | 5.8 | 3.65 | 2.75 | 2.85 | 2.7 | [a] 3.3 | 2.75 | 2.85 |
| 13 | 3.0 | 3.1 | 3.65 | 4.1 | 5.6 | 3.65 | 2.85 | 2.85 | 2.68 | 2.75 | 2.7 | 2.85 |
| 14 | 3.05 | 3.1 | 3.8 | 3.9 | 5.4 | 3.68 | 2.95 | 2.85 | 2.7 | 2.75 | 2.7 | 2.8 |
| 15 | 3.0 | 3.2 | 3.85 | 3.85 | 5.2 | 3.4 | 2.9 | 2.85 | 2.7 | 2.75 | 2.8 | 2.8 |
| 16 | 3.0 | 3.3 | 3.67 | 3.85 | 4.1 | 3.1 | 2.9 | 2.85 | 2.72 | 2.8 | 2.8 | 2.85 |
| 17 | 3.0 | 3.3 | 3.65 | 3.82 | 4.3 | 3.0 | 2.95 | 2.85 | 2.6 | 2.85 | 2.8 | 2.8 |
| 18 | 3.0 | 3.3 | 3.6 | 3.9 | 4.1 | 3.0 | 2.98 | 2.85 | 2.6 | 2.85 | [a] 3.0 | 2.8 |

[a] River flooded to run logs. Water stored during preceding night. No change in normal flow.

*Daily gage height, in feet, of Grande Ronde River at Hilgard, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 3.0 | 3.2 | 3.62 | 3.85 | 4.1 | 3.05 | 2.99 | 2.85 | 2.65 | 2.85 | 2.85 | 2.8 |
| 20 | 3.0 | 3.2 | 3.7 | 3.85 | 4.1 | 3.05 | 2.9 | 2.8 | 2.65 | 2.8 | 2.8 | 2.8 |
| 21 | 3.0 | 3.35 | 3.97 | 4.0 | 4.1 | 2.7 | 2.85 | 2.85 | 2.7 | 2.8 | 2.8 | 2.8 |
| 22 | 3.0 | 3.45 | 3.97 | 4.25 | 4.0 | 2.5 | 2.85 | 2.85 | 2.7 | 2.85 | 2.75 | 2.8 |
| 23 | 3.1 | 3.6 | 3.95 | 4.0 | 4.0 | 2.3 | 2.8 | 2.8 | 2.65 | 2.8 | 2.75 | 3.0 |
| 24 | 3.3 | 3.45 | 3.8 | 4.0 | 4.0 | 2.3 | 2.8 | 2.8 | 2.7 | 2.85 | 2.8 | 2.9 |
| 25 | 3.3 | 3.7 | 3.75 | 4.1 | 3.9 | 2.2 | 2.8 | 2.85 | 2.7 | 2.85 | 2.8 | 2.85 |
| 26 | 3.25 | 3.9 | 4.1 | [a] 4.65 | 3.85 | 2.2 | 2.8 | 2.8 | 2.7 | 2.85 | 2.8 | 2.9 |
| 27 | 3.35 | 3.85 | 4.1 | 4.25 | 3.8 | 3.3 | 2.8 | 2.8 | 2.72 | [a] 3.1 | 2.85 | 3.1 |
| 28 | 3.5 | 3.8 | 4.0 | 4.3 | 3.8 | 3.25 | 2.85 | 2.8 | 2.7 | 2.85 | 2.85 | 3.1 |
| 29 | 3.4 | ....... | 4.0 | 4.55 | 3.8 | 2.35 | 2.85 | 2.75 | 2.7 | 2.8 | 2.85 | 3.1 |
| 30 | 3.2 | ....... | 3.9 | 4.5 | 3.8 | 2.2 | 2.85 | 2.7 | 2.68 | 2.75 | 2.85 | 3.1 |
| 31 | 3.1 | ....... | 3.9 | ....... | 3.75 | ....... | 2.85 | 2.7 | ....... | 2.75 | ....... | 3.1 |

[a] River flooded to run logs. Water stored during preceding night. No change in normal flow.

NOTE.—Ice conditions during part of January, February, and December.

*Station rating table for Grande Ronde River at Hilgard, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.20 | 3 | 3.40 | 228 | 4.60 | 1,070 | 5.80 | 2,466 |
| 2.30 | 5 | 3.50 | 272 | 4.70 | 1,170 | 5.90 | 2,592 |
| 2.40 | 8 | 3.60 | 320 | 4.80 | 1,275 | 6.00 | 2,717 |
| 2.50 | 12 | 3.70 | 370 | 4.90 | 1,384 | 6.20 | 2,969 |
| 2.60 | 18 | 3.80 | 425 | 5.00 | 1,495 | 6.40 | 3,221 |
| 2.70 | 26 | 3.90 | 485 | 5.10 | 1,608 | 6.60 | 3,473 |
| 2.80 | 38 | 4.00 | 550 | 5.20 | 1,725 | 6.80 | 3,725 |
| 2.90 | 58 | 4.10 | 620 | 5.30 | 1,846 | 7.00 | 3,977 |
| 3.00 | 84 | 4.20 | 700 | 5.40 | 1,968 | 7.20 | 4,229 |
| 3.10 | 114 | 4.30 | 785 | 5.50 | 2,092 | 7.40 | 4,481 |
| 3.20 | 148 | 4.40 | 875 | 5.60 | 2,216 | 7.60 | 4,733 |
| 3.30 | 186 | 4.50 | 970 | 5.70 | 2,341 | 7.80 | 4,985 |

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1904-5. It is well defined between gage heights 2.8 feet and 5.5 feet. Below gage height 2.8 feet the table is very uncertain. The table has been extended beyond these limits. Above gage heights 4.7 feet the table is the same as in 1904.

*Estimated monthly discharge of Grande Ronde River at Hilgard, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 272 | 48 | 108 | 6,641 |
| February | 485 | 38 | 180 | 9,997 |
| March | 620 | 320 | 461 | 28,350 |
| April | 1,020 | 440 | 597 | 35,520 |
| May | 2,466 | 398 | 1,127 | 69,300 |
| June | 485 | 3 | 227 | 13,510 |
| July | 148 | 3 | 60.6 | 3,726 |
| August | 48 | 26 | 44.1 | 2,712 |
| September | 38 | 18 | 24.3 | 1,446 |
| October | 48 | 26 | 37.1 | 2,281 |
| November | 48 | 26 | 39.6 | 2,356 |
| December | 114 | 32 | 54.6 | 3,357 |
| The year | 3,725 | 3 | 247 | 179,200 |

NOTE.—Extremely low gage heights probably due to storage above.

## GRANDE RONDE RIVER AT ELGIN, OREG.

This station was established November 20, 1903, by John H. Lewis. It is located at the county bridge on the road from Elgin to Wallowa, Oreg., and is one-fourth mile east of the railroad station. It is at the lower end of the Grande Ronde Valley, a broad, flat, fertile valley in which much of the water is used for the irrigation of fruit, sugar beets, and other crops. The valley contains over 200 square miles, its width being about 12 miles and its length more than 20. Its upper end is about 6 miles below the Hilgard station. Some water is received from a number of small streams rising in the hills which surround the valley.

The channel is curved above a point 30 feet above the bridge, and is straight for 200 feet below. The right bank is high, rocky, free from vegetation, and will not overflow. The left bank is low, free from vegetation, and will overflow only under the trestle approach. The bed of the stream is uneven, covered with large bowlders, and is free from vegetation. It is not liable to shift. The channel is broken by the piers and the trestle bent at high water.

Discharge measurements are made from the downstream side of the bridge, which has a span between piers of 100 feet, with 130 feet of trestle approach from the left bank and 30 feet of approach from the right bank. The initial point for soundings is on the right bank directly over the center of the bent, 30 feet from the caisson.

A standard chain gage is attached to the upstream side of the bridge, near the center of the stream; length of chain, 22.00 feet. During 1905 the gage was read once each day by John Graham. The bench mark is the top surface of the steel caisson directly over the gage; elevation, 15.14 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of United States Geological Survey:

Description: 100, p 419; 135, pp 226-227.
Discharge: 100, p 419; 135, p 227.
Discharge, monthly: 135, p 229.
Gage heights: 100, p 419; 135, pp 227-228.
Rating table: 135, p 228.

*Discharge measurements of Grande Ronde River at Elgin, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 1 | W. C. Sawyer | 86 | 336 | 2.60 | 3.25 | 872 |
| May 22 | do | 92 | 356 | 2.81 | 3.48 | 1,000 |
| September 21 | do | 32 | 27 | 1.37 | 1.48 | 37.5 |
| November 30 | R. S. Hall | 88 | 221 | .36 | 1.74 | 80 |

*Daily gage height, in feet, of Grande Ronde River at Elgin, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.6 | 2.25 | 3.0 | 3.25 | 3.5 | 3.2 | 2.3 | 1.4 | 1.35 | 1.7 | 1.7 | 1.75 |
| 2 | 2.45 | 2.4 | 2.95 | 3.2 | 3.5 | 3.25 | 2.3 | 1.4 | 1.35 | 1.65 | 1.7 | 1.75 |
| 3 | 2.45 | 2.1 | 3.05 | 3.35 | 3.55 | 3.25 | 2.2 | 1.35 | 1.35 | 1.65 | 1.7 | 1.7 |
| 4 | 2.25 | 2.05 | 3.1 | 3.3 | 3.75 | 3.25 | 2.15 | 1.35 | 1.35 | 1.65 | 1.7 | 1.75 |
| 5 | 2.25 | 2.05 | 3.1 | 3.3 | 4.0 | 3.3 | ....... | 1.35 | 1.35 | 1.65 | 1.7 | 1.8 |
| 6 | 2.2 | 2.05 | 3.05 | 3.5 | 4.05 | 3.3 | 2.1 | 1.35 | 1.35 | 1.7 | 1.75 | 1.8 |
| 7 | 2.1 | 2.0 | 3.05 | 3.5 | 4.05 | 3.3 | 2.05 | 1.35 | 1.35 | 1.65 | 1.85 | 1.8 |
| 8 | 2.1 | 1.9 | 2.95 | 3.6 | 4.16 | 3.2 | 1.9 | 1.35 | 1.35 | 1.65 | 1.85 | 1.75 |
| 9 | 1.95 | 1.95 | 2.95 | 3.6 | 4.15 | 3.1 | 1.8 | 1.35 | 1.35 | 1.65 | 1.65 | 1.75 |
| 10 | 2.0 | 1.95 | 2.8 | 3.6 | 4.15 | 3.1 | 1.75 | 1.35 | 1.35 | 1.65 | 1.55 | ...... |
| 11 | 2.1 | a 3.05 | 2.8 | 3.45 | 4.1 | 3.05 | 1.7 | 1.35 | 1.4 | 1.65 | 1.55 | 2.15 |
| 12 | 2.1 | a 3.2 | 2.8 | 3.4 | 4.0 | 3.05 | 1.7 | 1.35 | 1.4 | 1.7 | 1.55 | 2.15 |
| 13 | 2.05 | a 2.7 | 2.75 | 3.3 | 3.9 | 3.05 | 1.65 | 1.35 | 1.4 | 1.75 | 1.55 | 1.95 |
| 14 | 2.05 | a 2.3 | 2.85 | 3.2 | 3.9 | 3.05 | 1.65 | 1.35 | 1.4 | 1.8 | 1.55 | 1.85 |
| 15 | 2.05 | 1.95 | 3.0 | 3.1 | 3.8 | 3.0 | 1.65 | 1.35 | 1.4 | 1.8 | 1.65 | 1.9 |
| 16 | 2.05 | 1.95 | 3.1 | 3.15 | 3.75 | 2.95 | 1.65 | 1.35 | 1.4 | 1.7 | 1.7 | 1.9 |
| 17 | 2.05 | 2.05 | 3.0 | 3.15 | 3.7 | 2.8 | 1.6 | 1.4 | 1.4 | 1.7 | 1.7 | 1.85 |
| 18 | 2.05 | 1.9 | 2.85 | 3.1 | 3.75 | 2.7 | 1.6 | 1.4 | 1.4 | 1.7 | 1.7 | 1.85 |
| 19 | 2.1 | 1.9 | 3.0 | 3.1 | 3.75 | 2.65 | 1.55 | 1.4 | 1.45 | 1.7 | 1.7 | 1.85 |
| 20 | 2.2 | 1.95 | 3.0 | 3.15 | 3.65 | 2.6 | 1.55 | 1.4 | 1.45 | 1.7 | 1.75 | 1.85 |
| 21 | 2.05 | 2.1 | 3.15 | 3.4 | 3.55 | 2.55 | 1.6 | 1.35 | 1.5 | 1.75 | 1.7 | 1.85 |
| 22 | ...... | 2.2 | 3.2 | 3.4 | 3.5 | 2.45 | 1.55 | 1.35 | 1.5 | 1.75 | 1.6 | 2.0 |
| 23 | 2.45 | 2.3 | 3.25 | ....... | 3.4 | 2.45 | 1.5 | 1.35 | 1.5 | 1.75 | 1.65 | 1.8 |
| 24 | 2.45 | 2.4 | 3.2 | 3.45 | 3.4 | 2.5 | 1.5 | 1.35 | 1.5 | 1.75 | 1.85 | 1.9 |
| 25 | 2.45 | 2.6 | 3.15 | 3.6 | 3.4 | 2.3 | 1.5 | 1.35 | 1.5 | 1.75 | 1.65 | 1.8 |
| 26 | 2.55 | 2.8 | 3.2 | 3.65 | 3.3 | 2.45 | 1.5 | 1.35 | 1.5 | 1.75 | 1.55 | 1.95 |
| 27 | 2.55 | 3.0 | 3.3 | 3.7 | 3.2 | 2.45 | 1.45 | 1.35 | 1.65 | 2.0 | 1.65 | 1.85 |
| 28 | 2.55 | 3.0 | ....... | 3.6 | 3.25 | 2.45 | 1.45 | 1.35 | 1.65 | 2.0 | 1.6 | a 2.0 |
| 29 | 2.65 | ....... | 3.35 | 3.6 | 3.2 | 2.45 | 1.4 | 1.3 | 1.7 | 2.0 | 1.95 | a 1.95 |
| 30 | 2.45 | ....... | 3.3 | 3.5 | 3.2 | 2.4 | 1.4 | 1.35 | 1.7 | 1.75 | 1.75 | a 1.9 |
| 31 | 2.3 | ....... | 3.2 | ....... | 3.2 | ....... | 1.4 | 1.35 | ....... | 1.75 | ....... | a 1.9 |

[a] Rise caused by ice gorges; no increased flow.

*Station rating table for Grande Ronde River at Elgin, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.30 | 15 | 2.10 | 205 | 2.90 | 590 | 3.70 | 1,310 |
| 1.40 | 27 | 2.20 | 240 | 3.00 | 655 | 3.80 | 1,430 |
| 1.50 | 42 | 2.30 | 280 | 3.10 | 725 | 3.90 | 1,560 |
| 1.60 | 60 | 2.40 | 325 | 3.20 | 805 | 4.00 | 1,700 |
| 1.70 | 82 | 2.50 | 370 | 3.30 | 890 | 4.10 | 1,840 |
| 1.80 | 108 | 2.60 | 420 | 3.40 | 980 | 4.20 | 1,990 |
| 1.90 | 138 | 2.70 | 475 | 3.50 | 1,080 | | |
| 2.00 | 170 | 2.80 | 530 | 3.60 | 1,190 | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904-5. It is well defined between gage heights 1.5 feet and 3.5 feet.

*Estimated monthly discharge of Grande Ronde River at Elgin, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 448 | 154 | 269 | 16,540 |
| February | 655 | 138 | 244 | 13,550 |
| March | 935 | 502 | 703 | 43,230 |
| April | 1,310 | 725 | 983 | 58,490 |
| May | 1,930 | 805 | 1,308 | 80,430 |
| June | 890 | 280 | 588 | 34,990 |
| July | 280 | 27 | 98.7 | 6,069 |
| August | 27 | 15 | 22.0 | 1,353 |
| September | 82 | 21 | 35.1 | 2,089 |
| October | 170 | 71 | 92.8 | 5,706 |
| November | 123 | 51 | 74.6 | 4,439 |
| December | 222 | 82 | 127 | 7,809 |
| The year | 1,930 | 15 | 379 | 274,700 |

NOTE.—Discharge interpolated for missing gage heights.

## GRANDE RONDE RIVER AT ZINDEL, WASH.

This station was established June 30, 1904, by W. G. Steward. It is located at Zindel Ferry, 2 miles above the mouth of the river and 1½ miles below Joseph Creek.

The channel is curved above the station, but is straight for 1,200 feet below. There are rapids 600 feet above and also 1,200 feet below the station. The right bank is rocky and slopes gradually. It is liable to overflow at extreme high water. The left bank is high, rocky, and not liable to overflow. The bed is rocky and permanent. It is fairly even for soundings. There is one channel at all stages.

Discharge measurements are made from the ferryboat. The distances are measured on the stay line used for the ferry. The initial point is an 8-penny nail in a pine tree 30 feet south of the cable post on the right bank.

An inclined gage is located on the left bank just below the ferry. During 1905 the gage was read once each day by M. W. Zindel, who is paid by the Lewiston Water and Power Company. The bench mark is a point on a rock 29 feet downstream from the gage; elevation, 9.00 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 229–230.

*Daily gage height, in feet, of Grande Ronde River at Zindel, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.65 | 2.7 | 3.4 | 4.0 | 4.0 | 4.8 | 3.3 | 2.2 | 2.0 | 2.3 | 2.4 | 2.3 |
| 2 | 2.5 | 2.65 | 3.5 | 3.9 | 4.0 | 5.0 | 3.3 | 2.2 | 2.0 | 2.3 | 2.35 | 2.3 |
| 3 | 2.5 | 2.6 | 3.6 | 3.9 | 4.1 | 4.9 | 3.3 | 2.2 | 2.0 | 2.3 | 2.3 | 2.3 |
| 4 | 2.5 | 2.4 | 3.75 | 3.9 | 4.1 | 5.1 | 3.3 | 2.2 | 2.0 | 2.25 | 2.3 | 2.3 |
| 5 | 2.5 | 2.5 | 3.75 | 4.0 | 4.1 | 5.0 | 3.3 | 2.2 | 2.0 | 2.2 | 2.3 | 2.3 |
| 6 | 2.55 | 2.5 | 3.6 | 4.0 | 4.4 | 4.8 | 3.3 | 2.2 | 2.0 | 2.25 | 2.25 | 2.3 |
| 7 | 2.3 | 2.5 | 3.6 | 4.1 | 4.4 | 4.7 | 3.2 | 2.1 | 2.0 | 2.3 | 2.25 | 2.3 |
| 8 | 2.3 | 2.45 | 3.6 | 4.2 | 4.4 | 4.6 | 3.1 | 2.0 | 2.0 | 2.3 | 2.25 | 2.1 |
| 9 | 2.25 | 2.4 | 3.6 | 4.2 | 4.5 | 5.1 | 3.0 | 2.0 | 2.0 | 2.3 | 2.2 | 2.1 |
| 10 | 2.25 | 2.3 | 3.5 | 4.2 | 4.6 | 4.5 | 3.0 | 2.0 | 2.0 | 2.3 | 2.2 | 2.0 |
| 11 | 2.2 | 2.3 | 3.4 | 4.0 | 4.8 | 4.8 | 3.0 | 2.0 | 1.95 | 2.3 | 2.2 | 2.0 |
| 12 | 2.2 | 2.25 | 3.3 | 3.9 | 4.8 | 4.8 | 2.9 | 2.0 | 1.95 | 2.3 | 2.2 | 2.25 |
| 13 | 2.2 | 2.2 | 3.4 | 3.8 | 4.7 | 4.0 | 2.7 | 2.0 | 2.0 | 2.35 | 2.2 | 2.25 |

*Daily gage height, in feet, of Grande Ronde River at Zindel, Wash., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 2.25 | 2.2 | 3.4 | 3.7 | 4.5 | 4.0 | 2.7 | 2.0 | 2.0 | 2.35 | 2.2 | 2.25 |
| 15 | 2.25 | 2.2 | 3.4 | 3.7 | 4.3 | 3.9 | 2.6 | 2.0 | 2.0 | 2.35 | 2.2 | 2.3 |
| 16 | 2.25 | 2.2 | 3.5 | 3.7 | 4.2 | 3.9 | 2.5 | 2.0 | 2.0 | 2.35 | 2.2 | 2.3 |
| 17 | 2.3 | 2.25 | 3.7 | 3.7 | 4.55 | 3.8 | 2.5 | 2.0 | 2.0 | 2.35 | 2.25 | 2.3 |
| 18 | 2.3 | 2.3 | 3.8 | 3.8 | 4.5 | 3.8 | 2.5 | 2.0 | 2.0 | 2.3 | 2.25 | 2.3 |
| 19 | 2.4 | 2.3 | 3.7 | 3.9 | 4.4 | 3.8 | 2.5 | 2.0 | 2.0 | 2.3 | 2.25 | 2.3 |
| 20 | 2.4 | 2.4 | 3.8 | 4.1 | 4.4 | 3.8 | 2.5 | 2.0 | 2.0 | 2.3 | 2.25 | 2.3 |
| 21 | 2.4 | 2.95 | 3.8 | 4.1 | 4.4 | 3.7 | 2.3 | 2.0 | 2.0 | 2.3 | 2.2 | 2.3 |
| 22 | 2.4 | 2.9 | 3.8 | 4.1 | 4.2 | 3.7 | 2.3 | 2.0 | 2.0 | 2.3 | 2.2 | 2.25 |
| 23 | 2.4 | 2.9 | 3.9 | 4.2 | 4.2 | 3.7 | 2.3 | 2.0 | 2.0 | 2.3 | 2.2 | 2.1 |
| 24 | 2.8 | 3.1 | 3.9 | 4.3 | 4.1 | 3.9 | 2.3 | 2.0 | 2.0 | 2.3 | 2.2 | 2.1 |
| 25 | 3.2 | 3.2 | 4.1 | 4.3 | 4.0 | 3.8 | 2.3 | 2.0 | 2.0 | 2.3 | 2.25 | 2.25 |
| 26 | 3.1 | 3.35 | 4.1 | 4.5 | 3.9 | 3.8 | 2.2 | 2.0 | 2.0 | 2.4 | 2.3 | 2.3 |
| 27 | 3.2 | 3.5 | 4.3 | 4.6 | 4.0 | 3.6 | 2.2 | 2.0 | 2.1 | 2.5 | 2.6 | 2.3 |
| 28 | 3.1 | 3.4 | 4.2 | 4.6 | 4.1 | 3.6 | 2.2 | 2.0 | 2.1 | 2.4 | 2.6 | 2.3 |
| 29 | 3.1 | ...... | 4.2 | 4.2 | 4.2 | 3.4 | 2.2 | 2.0 | 2.3 | 2.4 | 2.4 | 2.25 |
| 30 | 3.0 | ...... | 4.3 | 4.1 | 4.3 | 3.4 | 2.2 | 2.0 | 2.3 | 2.4 | 2.3 | 2.25 |
| 31 | 2.8 | ...... | 4.3 | ...... | 4.4 | ...... | 2.2 | 2.0 | ...... | 2.4 | ...... | 2.25 |

## WALLOWA LAKE NEAR JOSEPH, OREG.

July 15, 1905, a gage was placed on the upstream side of the controlling dam at the outlet of Wallowa Lake and was read twice each week during the remainder of the year. It is fastened to the crib pier nearest the right bank. Its datum is the floor of the sluiceway

*Daily gage height, in feet, of Wallowa Lake near Joseph, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 0.65 | | 16 | | 1.0 | 0.75 | | | 0.6 |
| 2 | | 2.1 | 0.85 | | | 0.6 | 18 | | | | 0.7 | 0.6 | |
| 4 | | | | 0.8 | .65 | | 19 | 4.2 | 1.0 | .65 | | | |
| 5 | | 1.6 | | | | | 21 | | | | .7 | | |
| 6 | | | .8 | | .65 | .6 | 22 | 3.7 | | | | .6 | |
| 7 | | | | .8 | | | 23 | | .9 | .7 | | | .6 |
| 9 | | | .75 | | | .6 | 25 | | | | .7 | .6 | |
| 10 | | 1.3 | | | | | 26 | 3.6 | | | | | |
| 11 | | | | | .6 | | 27 | | | .75 | | | .6 |
| 12 | | 1.1 | | | | | 28 | | | | .65 | | |
| 13 | | | .8 | | | .6 | 29 | 3.1 | | | | .6 | |
| 15 | 4.5 | | | | | | 30 | | .9 | .85 | | | |

## WALLOWA RIVER NEAR JOSEPH, OREG.

This station was established November 12, 1903, by John H. Lewis. It is located 500 feet below the outlet of Wallowa Lake, about 1¼ miles above Joseph, Oreg.

The channel is straight for 100 feet above and 75 feet below the station. The right bank is liable to overflow at high water for about 30 feet, at which point it becomes steep. The left bank will overflow for about 20 feet at high water. Both banks are timbered. At the bridge the bed of the stream is composed of large bowlders, is free from vegetation, and is not liable to shift. There is but one channel at all stages.

Discharge measurements are made from a footbridge, which has a single span of 50 feet. The initial point for soundings is the end of the upstream log supporting the footbridge on the left bank.

The original gage was a vertical staff located on Wallowa Lake near the outlet. On account of the construction of a controlling dam at the outlet, this gage was rendered useless. From March 30 to July 12, 1905, readings were taken on a temporary gage about 100 feet below the dam. July 12, 1905, a permanent vertical rod gage was established on the right bank of the river, about 50 feet above the footbridge. The readings on the temporary gage have been reduced to correspond with those on the permanent one. During 1905 the gage was read once each day by F. L. Bedingfield. The new gage is referred to the following bench mark: A cross cut in the highest point of the rock to which the gage is attached; elevation, 4.10 feet above the datum of the gage.

Four irrigation ditches divert a considerable portion of the water between the station and the town of Joseph, and gages have been read on them twice weekly since July 12.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 418; 135, pp 230–231.
Discharge: 100, p 418; 135, p 231.
Discharge, monthly: 135, p 232.
Gage heights: 100, p 418; 135, p 231.
Rating table: 135, p 232.

*Discharge measurements of Wallowa River near Joseph, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 30 | W. C. Sawyer | 27 | 34.5 | 2.37 | 1.51 | 82 |
| May 18 | do | 27 | 42.0 | 2.43 | 2.20 | 102 |
| July 10 | do | 28 | 50.0 | 4.08 | 2.43 | 202 |
| July 11 | do | 27 | 36.1 | 3.62 | 2.30 | 131 |
| July 11 | do | 28 | 52.0 | 4.63 | 2.58 | 239 |
| July 11 | do | 27 | 29.5 | 2.82 | 2.17 | 83 |
| July 12 | do | 30 | 61.0 | 5.20 | 2.74 | 319 |
| September 19 | do | 27 | 25.5 | 2.31 | 2.05 | 59 |
| November 27 | R. S. Hall | 28 | 32.4 | 2.33 | 2.02 | 76 |

*Daily gage height, in feet, of Wallowa River near Joseph, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.4 | 1.2 | 1.2 | 2.0 | 2.15 | 2.95 | 2.7 | 2.8 | 2.15 | 2.1 | 2.0 | 1.9 |
| 2 | 1.4 | 1.2 | 1.2 | 2.0 | 2.15 | 3.15 | 2.6 | 2.8 | ....... | 2.1 | 2.0 | 1.9 |
| 3 | 1.4 | 1.2 | 1.2 | 2.0 | 2.15 | 3.2 | 2.6 | 2.7 | 2.1 | 2.1 | 2.0 | 1.9 |
| 4 | 1.4 | 1.2 | 1.2 | 2.0 | 2.15 | 3.2 | 2.6 | 2.7 | 2.1 | 2.1 | 2.0 | 1.9 |
| 5 | 1.3 | 1.2 | 1.2 | 2.0 | ....... | 3.3 | 2.6 | 2.6 | 2.1 | 2.1 | 2.0 | 1.9 |
| 6 | 1.3 | 1.2 | 1.2 | 2.0 | 2.15 | 3.35 | 2.7 | 2.55 | 2.1 | 2.15 | 2.0 | 1.9 |
| 7 | 1.3 | 1.2 | 1.2 | 2.0 | 2.15 | 3.3 | 2.75 | 2.5 | 2.1 | 2.2 | 2.0 | ...... |
| 8 | 1.3 | 1.2 | 1.2 | 2.0 | 2.15 | 3.2 | 2.75 | 2.5 | 2.1 | 2.2 | 2.0 | 1.9 |
| 9 | 1.3 | 1.1 | 1.2 | 2.0 | 2.15 | 3.05 | 2.6 | 2.5 | 2.1 | 2.2 | 2.0 | 1.9 |
| 10 | ........ | 1.1 | 1.2 | 2.05 | 2.05 | 3.05 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 1.9 |
| 11 | 1.3 | 1.2 | 1.2 | 2.05 | 2.05 | 3.15 | 2.6 | 2.4 | 2.1 | 2.1 | 2.0 | 1.9 |
| 12 | 1.3 | 1.2 | 1.2 | 2.0 | 2.05 | 3.05 | 2.5 | 2.4 | 2.1 | 2.1 | 2.0 | 1.9 |
| 13 | 1.3 | 1.2 | ....... | 2.0 | 2.05 | 3.15 | 2.8 | 2.4 | 2.1 | 2.1 | 2.0 | 1.9 |
| 14 | 1.3 | 1.2 | ....... | ....... | 2.05 | 3.15 | 2.8 | 2.4 | 2.1 | 2.1 | 2.0 | 1.9 |

*Daily gage height, in feet, of Wallowa River near Joseph, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 1.3 | 1.2 | 1.2 | 2.0 | 2.0 | 3.05 | 2.7 | 2.35 | 2.1 | 2.1 | 2.0 | 1.9 |
| 16 | 1.3 | 1.2 | 1.3 | 2.0 | 2.0 | 3.05 | 2.7 | 2.3 | 2.05 | 2.1 | 2.0 | 1.9 |
| 17 | 1.3 | 1.2 | 1.3 | 2.05 | 2.0 | 3.05 | 2.6 | 2.3 | 2.0 | 2.1 | 2.0 | 1.9 |
| 18 | 1.3 | 1.2 | 1.3 | 2.05 | 2.0 | 3.05 | 2.6 | 2.3 | 2.05 | 2.1 | 2.0 | 1.9 |
| 19 | 1.3 | 1.2 | 1.3 | 2.05 | 2.2 | 2.95 | 2.6 | 2.3 | 2.0 | 2.1 | 2.0 | 1.9 |
| 20 | 1.2 | ...... | 1.4 | 2.05 | 2.15 | 2.85 | 2.7 | 2.25 | 2.0 | 2.1 | 2.0 | 1.9 |
| 21 | 1.2 | 1.3 | ...... | 2.1 | 2.1 | 2.9 | 2.8 | 2.25 | 2.0 | 2.1 | 2.0 | 1.9 |
| 22 | 1.3 | 1.2 | ...... | 2.1 | 2.1 | 2.9 | 2.8 | 2.3 | 2.0 | 2.05 | 1.95 | 1.9 |
| 23 | 1.3 | 1.2 | ...... | 2.1 | 2.15 | 2.9 | 2.8 | 2.25 | 2.0 | 2.05 | 1.95 | 1.9 |
| 24 | ...... | 1.2 | 1.4 | 2.1 | 2.25 | 2.85 | 2.7 | 2.25 | ...... | 2.05 | 1.9 | 1.9 |
| 25 | ...... | 1.2 | ...... | 2.1 | 2.3 | 2.8 | 2.8 | 2.25 | 2.0 | 2.05 | 1.9 | 1.9 |
| 26 | 1.3 | 1.2 | 1.4 | 2.1 | 2.2 | 2.8 | 2.6 | 2.25 | 2.0 | 2.05 | 1.9 | 1.9 |
| 27 | 1.3 | 1.2 | 1.4 | 2.1 | 2.2 | 2.75 | 2.7 | 2.2 | 2.0 | 2.05 | 1.95 | 1.9 |
| 28 | 1.3 | 1.2 | ...... | 2.1 | 2.1 | 2.6 | 2.7 | 2.2 | 2.05 | 2.0 | 1.95 | 1.9 |
| 29 | 1.3 | ...... | 1.5 | 2.15 | 2.15 | 2.6 | 2.7 | 2.2 | 2.2 | 2.0 | 1.95 | 1.9 |
| 30 | ...... | ...... | 1.6 | 2.15 | 2.15 | 2.6 | ...... | 2.2 | 2.2 | 2.0 | 1.95 | 1.95 |
| 31 | 1.3 | ...... | 2.0 | ...... | 2.9 | ...... | 2.8 | 2.2 | ...... | 2.0 | ...... | 1.9 |

NOTE.—Gage heights, January 1 to March 30, refer to lake-gage datum. During the remainder of the year gage heights refer to new gage.

*Station rating table for Wallowa River near Joseph, Oreg., from November 13, 1903, to March 30, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 53 | 2.00 | 157 | 2.80 | 344 | 3.60 | 609 |
| 1.30 | 63 | 2.10 | 175 | 2.90 | 374 | 3.70 | 643 |
| 1.40 | 73 | 2.20 | 195 | 3.00 | 406 | 3.80 | 677 |
| 1.50 | 85 | 2.30 | 216 | 3.10 | 439 | 3.90 | 711 |
| 1.60 | 97 | 2.40 | 238 | 3.20 | 473 | 4.00 | 745 |
| 1.70 | 110 | 2.50 | 262 | 3.30 | 507 | | |
| 1.80 | 125 | 2.60 | 288 | 3.40 | 541 | | |
| 1.90 | 141 | 2.70 | 315 | 3.50 | 575 | | |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1903-4. It is well defined between gage heights 1.5 feet and 3 feet.

*Station rating table for Wallowa River near Joseph, Oreg., from March 31 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.90 | 35 | 2.30 | 135 | 2.70 | 299 | 3.10 | 527 |
| 2.00 | 54 | 2.40 | 170 | 2.80 | 350 | 3.20 | 597 |
| 2.10 | 77 | 2.50 | 209 | 2.90 | 405 | 3.30 | 675 |
| 2.20 | 104 | 2.60 | 252 | 3.00 | 464 | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is well defined between gage heights 2 feet and 2.8 feet.

*Estimated monthly discharge of Wallowa River near Joseph, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 73 | 53 | 63.6 | 3,911 |
| February | 63 | 45 | 53.0 | 2,943 |
| March | 97 | 53 | 62.6 | 3,849 |
| April | 90 | 54 | 64.7 | 3,850 |
| May | 405 | 54 | 94.0 | 5,780 |
| June | 717 | 252 | 473 | 28,140 |
| July | 350 | 209 | 293 | 18,020 |
| August | 350 | 104 | 172 | 10,580 |
| September | 104 | 54 | 70.8 | 4,213 |
| October | 104 | 54 | 74.7 | 4,593 |
| November | 54 | 35 | 50.1 | 2,981 |
| December | 44 | 35 | 35.3 | 2,170 |
| The year | 717 | 35 | 126 | 91,030 |

## WALLOWA RIVER NEAR WALLOWA, OREG.

This station was established November 14, 1903, by John H. Lewis. It is located at the county bridge, 1½ miles below Wallowa, Oreg., and one-fourth mile below the mouth of Bear Creek. A small irrigation ditch takes water from the river about 300 feet above the bridge on the right bank.

The channel is straight for 400 feet above and 600 feet below the station. The current is swift. Both banks are low, wooded, and not liable to overflow. The bed of the stream is composed of gravel, is free from vegetation, and is not liable to shift. There is but one channel at low water. At high water the channel is broken by the rock-filled timber crib pier, to which the gage is fastened.

Discharge measurements are made from the upstream side of the bridge to which the gage is attached. The initial point for soundings is the left end of the lower chord on the upstream side of the bridge.

A staff gage is fastened vertically to the downstream side of the timber crib pier on the right bank. During 1905 the gage was read once each day by L. S. Johnson. Bench marks were established as follows: (1) The head of a 30-penny wire nail driven nearly flush with the top of the crib, 2 inches from the edge, near the gage; elevation, 6.60 feet. (2) A square chisel draft on top of a rock near the rail fence across the ditch 50 feet from the right end of the bridge; elevation, 8.10 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 417; 135, pp 232-233.
Discharge: 100, p 417; 135, p 233.
Discharge, monthly: 135, p 234.
Gage heights: 100, p 417; 135, pp 233-234.
Rating table: 135, p 234.

*Discharge measurements of Wallowa River near Wallowa, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 31 | W. C. Sawyer | 81.5 | 93 | 3.45 | 1.93 | 322 |
| May 19 | do | 88.0 | 173 | 4.71 | 2.86 | 816 |
| July 8 | do | 86.0 | 142 | 4.32 | 2.56 | 614 |
| September 18 | do | 84.0 | 80 | 2.49 | 1.72 | 199 |
| November 29 | R. S. Hall | 82.0 | 98 | 2.65 | 1.90 | 261 |

*Daily gage height, in feet, of Wallowa River near Wallowa, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 1.7 | 1.9 | 2.0 | 2.4 | 3.9 | 2.8 | 1.9 | 1.7 | 2.0 | 2.0 | 1.85 |
| 2 | 1.9 | 1.8 | 1.9 | 2.0 | 2.4 | 3.9 | 2.8 | 1.9 | 1.7 | 1.9 | 2.0 | 1.85 |
| 3 | 1.9 | 1.8 | 2.0 | 2.0 | 2.5 | 4.0 | 2.8 | 1.9 | 1.7 | 1.9 | 2.0 | 1.85 |
| 4 | 1.8 | 1.8 | 2.0 | 2.0 | 2.5 | 4.0 | 2.8 | 1.9 | 1.7 | 1.9 | 1.95 | 1.9 |
| 5 | 1.7 | 1.8 | 2.0 | 2.0 | 2.5 | 3.8 | 2.8 | 1.9 | 1.7 | 1.85 | 1.95 | 1.9 |
| 6 | 1.8 | 1.8 | 2.0 | 2.1 | 2.5 | 3.7 | 2.8 | 1.8 | 1.7 | 1.85 | 1.95 | 1.9 |
| 7 | 1.8 | 1.8 | 2.0 | 2.1 | 2.6 | 3.6 | 2.8 | 1.8 | 1.7 | 2.0 | 1.95 | 1.9 |
| 8 | 1.8 | 1.8 | 2.0 | 2.3 | 2.7 | 3.7 | 2.5 | 1.8 | 1.7 | 2.0 | 1.95 | 1.9 |
| 9 | 1.8 | 1.7 | 2.0 | 2.3 | 2.8 | 4.2 | 2.5 | 1.7 | 1.7 | 2.0 | 1.95 | 1.75 |
| 10 | 1.8 | 1.7 | 2.0 | 2.3 | 2.2 | 4.0 | 2.5 | 1.7 | 1.7 | 2.0 | 1.95 | 1.7 |
| 11 | 1.7 | 1.5 | 2.0 | 2.2 | 2.6 | 4.0 | 2.3 | 1.7 | 1.7 | 2.0 | 1.9 | 1.7 |
| 12 | 1.8 | 1.5 | 2.0 | 2.2 | 2.5 | 4.0 | 2.3 | 1.7 | 1.7 | 2.0 | 1.9 | 2.0 |
| 13 | 2.2 | 2.0 | 2.0 | 2.2 | 2.5 | 3.9 | 2.3 | 1.7 | 1.7 | 2.0 | 1.9 | 2.4 |
| 14 | 1.8 | 2.3 | 2.1 | 2.1 | 2.5 | 3.8 | 2.3 | 1.7 | 1.7 | 2.0 | 1.9 | 2.4 |
| 15 | 1.8 | 2.3 | 2.1 | 2.1 | 2.4 | 3.6 | 2.2 | 1.6 | 1.7 | 2.05 | 1.9 | 2.4 |
| 16 | 1.8 | 2.5 | 2.1 | 2.1 | 2.5 | 3.9 | 2.2 | 1.6 | 1.8 | 2.1 | 1.85 | 2.0 |
| 17 | 1.8 | 2.5 | 2.1 | 2.1 | 3.0 | 3.7 | 2.2 | 1.7 | 1.8 | 2.0 | 1.85 | 1.8 |
| 18 | 1.8 | 2.5 | 2.1 | 2.0 | 2.9 | 3.0 | 2.0 | 1.7 | 1.8 | 2.0 | 1.95 | 1.8 |
| 19 | 1.8 | 1.7 | 2.1 | 2.1 | 2.9 | 3.0 | 2.0 | 1.7 | 1.7 | 2.0 | 1 95 | 1.8 |
| 20 | 1.8 | 1.9 | 2.1 | 2.1 | 3.0 | 3.1 | 2.0 | 1.7 | 1.7 | 2.0 | 1.95 | 1.8 |
| 21 | 1.8 | 2.0 | 2.1 | 2.2 | 2.8 | 3.1 | 1.9 | 1.7 | 1.7 | 2.0 | 1.9 | 1.8 |
| 22 | 1.8 | 2.0 | 2.1 | 2.2 | 2.7 | 3.1 | 1.8 | 1.7 | 1.7 | 2.0 | 1.85 | 1.8 |
| 23 | 1.8 | 2.0 | 2.0 | 2.3 | 2.6 | 3.1 | 1.8 | 1.7 | 1.7 | 2.0 | 1.8 | 1.8 |
| 24 | 1.9 | 2.0 | 2.0 | 2.4 | 2.5 | 3.2 | 1.8 | 1.7 | 1.7 | 2.0 | 1.8 | 1.8 |
| 25 | 2.3 | 2.0 | 2.0 | 2.5 | 2.5 | 3.1 | 1.8 | 1.7 | 1.7 | 2.05 | 1.85 | 1.85 |
| 26 | 2.0 | 2.0 | 2.1 | 2.8 | 2.6 | 3.0 | 1.9 | 1.7 | 1.7 | 2.1 | 2.0 | 1.8 |
| 27 | 2.0 | 2.0 | 2.1 | 2.7 | 2.9 | 2.9 | 1.9 | 1.7 | 1.9 | 2.05 | 2.0 | 1.8 |
| 28 | 2.0 | 2.0 | 2.0 | 2.5 | 3.0 | 2.8 | 1.8 | 1.7 | 2.05 | 2.05 | 1.9 | 1.8 |
| 29 | 1.9 | ....... | 2.0 | 2.4 | 3.0 | 2.7 | 1.9 | 1.7 | 2.0 | 2.05 | 1.9 | 1.8 |
| 30 | 1.9 | ....... | 2.0 | 2.5 | 3.2 | 2.9 | 1.9 | 1.7 | 2.0 | 2.0 | 1.9 | 1.8 |
| 31 | 1.8 | ....... | 2.0 | ....... | 3.5 | ....... | 1.9 | 1.7 | ....... | 2.0 | ....... | 1.8 |

NOTE.—Anchor ice during part of January, February, and December.

*Station rating table for Wallowa River near Wallowa, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 140 | 2.20 | 412 | 2.90 | 862 | 3.60 | 1,616 |
| 1.60 | 168 | 2.30 | 462 | 3.00 | 960 | 3.70 | 1,730 |
| 1.70 | 200 | 2.40 | 514 | 3.10 | 1,063 | 3.80 | 1,844 |
| 1.80 | 236 | 2.50 | 568 | 3.20 | 1,169 | 3.90 | 1,958 |
| 1.90 | 276 | 2.60 | 626 | 3.30 | 1,277 | 4.00 | 2,072 |
| 2.00 | 318 | 2.70 | 693 | 3.40 | 1,388 | 4.10 | 2,186 |
| 2.10 | 364 | 2.80 | 772 | 3.50 | 1,502 | 4.20 | 2,300 |

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1903–1905. It is fairly well defined between gage heights 1.7 feet and 3.1 feet. The table has been extended beyond these limits.

Above gage height 2.6 feet the table is the same as that of 1904.

*Estimated monthly discharge of Wallowa River near Wallowa, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 462 | 200 | 264 | 16,230 |
| February | 318 | 140 | 228 | 12,660 |
| March | 364 | 276 | 332 | 20,410 |
| April | 772 | 318 | 431 | 25,650 |
| May | 1,502 | 412 | 715 | 43,960 |
| June | 2,300 | 693 | 1,505 | 89,550 |
| July | 772 | 236 | 451 | 27,730 |
| August | 276 | 168 | 214 | 13,160 |
| September | 341 | 200 | 219 | 13,030 |
| October | 364 | 256 | 317 | 19,490 |
| November | 318 | 236 | 285 | 16,960 |
| December | 514 | 200 | 274 | 16,850 |
| The year | 2,300 | 140 | 436 | 315,700 |

## WALLOWA RIVER NEAR ELGIN, OREG.

This station was established November 18, 1903, by John H. Lewis. It is located at the county highway bridge just below the mouth of Minam River, 12 miles from Elgin, Oreg. The station is in Wallowa Canyon about 9 miles below the lower end of Wallowa Valley.

The channel is straight for 100 feet above and 1,000 feet below the station. Both banks are high, rocky, not liable to overflow, and without timber or brush. The current is swift. The bed of the stream is composed of gravel, and is free from vegetation and not liable to shift. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the single-span bridge to which the gage is attached. On account of the velocity of the water a stay wire is used in making discharge measurements. The initial point for soundings is the end of the bridge rail on the left bank.

The gage is in two sections, located under the lower side of the bridge on the left bank. The lower or inclined section reads from 1.7 to 3 feet. The upper or vertical section reads from 3 to 10 feet. During 1905 the gage was read once each day by Samuel Spores and G. W. Weir. Bench marks were established as follows: (1) The highest point of the rock to which the vertical section of the gage is fastened, 6 inches from the gage rod; elevation, 9.60 feet. (2) The center of the hole in the rock in which the bolt supporting vertical rod is set; elevation, 7.07 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 416-417; 135, p 235.
Discharge: 100, p 417; 135, p 235.
Discharge, monthly: 135, p 237.
Gage heights: 100, p 417; 135, p 236.
Rating table: 135, p 236.

*Discharge measurements of Wallowa River near Elgin, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| April 1 | W. C. Sawyer | 140 | 218 | 3.66 | 2.85 | 800 |
| May 20 | do | 161 | 383 | 4.84 | 3.86 | 1,854 |
| July 7 | do | 160 | 296 | 3.74 | 3.27 | 1,107 |
| September 16 | do | 145 | 138 | 2.16 | 2.18 | 298 |
| November 30 [a] | R. S. Hall | 172 | 209 | 1.70 | 2.34 | 358 |

[a] Made at different section.

*Daily gage height, in feet, of Wallowa River near Elgin, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.4 | 2.7 | 2.9 | 3.2 | 4.9 | 3.3 | 2.4 | 2.0 | 2.45 | 2.5 | 2.3 |
| 2 | 2.5 | 2.4 | 2.7 | 2.9 | 3.2 | 5.0 | 3.5 | 2.4 | 2.0 | 2.4 | 2.6 | 2.3 |
| 3 | 2.5 | 2.4 | 2.8 | 2.9 | 3.3 | 5.0 | 3.5 | 2.4 | 2.0 | 2.4 | 2.6 | 2.3 |
| 4 | 2.3 | 2.4 | 2.8 | 2.9 | 3.3 | 4.9 | 3.5 | 2.4 | 2.0 | 2.35 | 2.6 | 2.3 |
| 5 | 2.3 | 2.3 | 2.8 | 3.0 | 3.5 | 4.7 | 3.5 | 2.4 | 2.0 | 2.35 | 2.55 | 2.3 |
| 6 | 2.3 | 2.3 | 2.8 | 3.0 | 3.5 | 4.4 | 3.4 | 2.3 | 2.0 | 2.35 | 2.5 | 2.3 |
| 7 | 2.3 | 2.3 | 2.8 | 3.1 | 3.6 | 4.4 | 3.4 | 2.3 | 2.0 | 2.6 | 2.5 | 2.3 |
| 8 | 2.2 | 2.2 | 2.7 | 3.1 | 3.7 | 4.6 | 3.3 | 2.3 | 2.0 | 2.55 | 2.5 | 2.3 |
| 9 | 2.2 | 2.1 | 2.7 | 3.1 | 3.7 | 5.0 | 3.2 | 2.3 | 2.0 | 2.55 | 2.5 | 2.3 |
| 10 | 2.1 | 2.0 | 2.7 | 3.1 | 3.6 | 4.9 | 3.2 | 2.3 | 2.0 | 2.5 | 2.5 | 2.05 |
| 11 | 2.1 | 2.0 | 2.7 | 3.0 | 3.5 | 4.9 | 3.1 | 2.3 | 2.0 | 2.55 | 2.45 | 2.05 |
| 12 | 2.2 | 2.0 | 2.7 | 3.0 | 3.4 | 4.8 | 2.9 | 2.3 | 2.0 | 2.6 | 2.45 | 2.1 |
| 13 | 2.3 | 2.0 | 2.7 | 3.0 | 3.3 | 4.6 | 2.8 | 2.2 | 2.0 | 2.6 | 2.45 | 2.1 |
| 14 | 2.3 | 2.2 | 2.9 | 2.9 | 3.3 | 4.4 | 2.6 | 2.1 | 2.0 | 2.6 | 2.4 | 2.1 |
| 15 | 2.4 | 2.2 | 2.9 | 2.9 | 3.3 | 4.2 | 2.7 | 2.1 | 2.0 | 2.7 | 2.4 | 2.15 |
| 16 | 2.4 | 2.3 | 2.9 | 2.9 | 3.4 | 3.6 | 2.6 | 2.1 | 2.0 | 2.65 | 2.4 | 2.15 |
| 17 | 2.4 | 2.4 | 2.8 | 2.9 | 3.9 | 3.5 | 2.6 | 2.1 | 2.2 | 2.7 | 2.4 | 2.2 |
| 18 | 2.4 | 2.6 | 2.8 | 2.8 | 3.8 | 3.8 | 2.5 | 2.1 | 2.2 | 2.6 | 2.4 | 2.2 |
| 19 | 2.4 | 2.5 | 2.8 | 2.8 | 3.8 | 3.8 | 2.5 | 2.1 | 2.2 | 2.6 | 2.45 | 2.2 |
| 20 | 2.3 | 2.5 | 2.8 | 2.9 | 4.0 | 3.9 | 2.5 | 2.0 | 2.2 | 2.6 | 2.5 | 2.3 |
| 21 | 2.3 | 2.5 | 2.8 | 2.9 | 3.7 | 4.0 | 2.5 | 2.0 | 2.2 | 2.6 | 2.5 | 2.4 |
| 22 | 2.3 | 2.5 | 2.8 | 3.0 | 3.6 | 4.1 | 2.5 | 2.0 | 2.2 | 2.55 | 2.5 | 2.3 |
| 23 | 2.3 | 2.5 | 2.8 | 3.2 | 3.5 | 3.9 | 2.5 | 2.0 | 2.2 | 2.6 | 2.35 | 2.35 |
| 24 | 2.4 | 2.6 | 2.8 | 3.3 | 3.4 | 4.0 | 2.5 | 2.0 | 2.2 | 2.65 | 2.35 | 2.3 |
| 25 | 2.8 | 2.7 | 2.8 | 3.4 | 3.3 | 3.8 | 2.5 | 2.0 | 2.2 | 2.65 | 2.4 | 2.4 |
| 26 | 2.6 | 2.7 | 2.8 | 3.7 | 3.4 | 3.7 | 2.5 | 2.0 | 2.2 | 2.8 | 2.4 | 2.5 |
| 27 | 2.6 | 2.7 | 2.9 | 3.5 | 3.8 | 3.6 | 2.5 | 2.0 | 2.25 | 2.7 | 2.35 | 2.6 |
| 28 | 2.6 | 2.7 | 2.9 | 3.3 | 3.8 | 3.5 | 2.5 | 2.0 | 2.5 | 2.6 | 2.3 | 2.4 |
| 29 | 2.5 | ....... | 2.9 | 3.2 | 3.9 | 3.4 | 2.4 | 2.0 | 2.6 | 2.6 | 2.3 | 2.4 |
| 30 | 2.4 | ....... | 2.9 | 3.3 | 4.2 | 3.3 | 2.4 | 2.0 | 2.45 | 2.6 | 2.3 | 2.4 |
| 31 | 2.4 | ....... | 2.9 | ....... | 4.9 | ....... | 2.4 | 2.0 | ....... | 2.55 | ....... | 2.85 |

**Note.**—No ice record.

*Station rating table for Wallowa River near Elgin, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 215 | 2.80 | 680 | 3.60 | 1,550 | 4.40 | 2,670 |
| 2.10 | 255 | 2.90 | 770 | 3.70 | 1,680 | 4.50 | 2,830 |
| 2.20 | 300 | 3.00 | 870 | 3.80 | 1,810 | 4.60 | 2,990 |
| 2.30 | 350 | 3.10 | 970 | 3.90 | 1,940 | 4.70 | 3,150 |
| 2.40 | 405 | 3.20 | 1,080 | 4.00 | 2,080 | 4.80 | 3,310 |
| 2.50 | 465 | 3.30 | 1,190 | 4.10 | 2,220 | 4.90 | 3,480 |
| 2.60 | 530 | 3.40 | 1,310 | 4.20 | 2,370 | 5.00 | 3,650 |
| 2.70 | 600 | 3.50 | 1,430 | 4.30 | 2,520 | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1903–1905. It is well defined between gage heights 2.2 feet and 4 feet.

*Estimated monthly discharge of Wallowa River near Elgin, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 680 | 255 | 396 | 24,350 |
| February | 600 | 215 | 401 | 22,270 |
| March | 770 | 600 | 683 | 42,000 |
| April | 1,680 | 680 | 944 | 56,170 |
| May | 3,480 | 1,080 | 1,581 | 97,210 |
| June | 3,650 | 1,190 | 2,451 | 145,800 |
| July | 1,430 | 405 | 768 | 47,220 |
| August | 405 | 215 | 287 | 17,650 |
| September | 530 | 215 | 273 | 16,240 |
| October | 680 | 378 | 512 | 31,480 |
| November | 530 | 350 | 434 | 25,820 |
| December | 725 | 235 | 355 | 21,830 |
| The year | 3,650 | 215 | 740 | 548,000 |

## DITCHES IN WALLOWA RIVER VALLEY, OREGON.

### SILVER LAKE DITCH NEAR JOSEPH, OREG.

This ditch diverts water from the right bank of Wallowa River about 1 mile above Joseph and one-eighth mile below the outlet of Wallowa Lake. Its head is 75 feet below the river gaging station.

The gage is a vertical rod on the left bank one-fourth mile below the bend, and is read twice a week by F. L. Bedingfield.

*Discharge measurements of Silver Lake ditch near Joseph, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet* | *Feet per second* | *Feet* | *Second-feet* |
| July 12 | W. C. Sawyer | 12 | 20.5 | 3.61 | 1.30 | 74.1 |
| September 19 | do | 11 | 10.4 | 1.55 | .43 | 16.1 |
| November 27 | do | 10 | 6.2 | .47 | .10 | 2.9 |

*Daily gage height, in feet, of Silver Lake ditch near Joseph, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 0.45 | | 16 | | 1.0 | 0.45 | | | 0.05 |
| 2 | | (a) | 0.5 | | | 0.05 | 18 | | | | 0.5 | 0.1 | |
| 4 | | | | 0.3 | .2 | | 19 | 1.3 | 1.0 | | | | |
| 5 | | 1.2 | | | | | 20 | | | .35 | | | |
| 6 | | | .45 | | | .05 | 21 | | | | .3 | | |
| 7 | | | | .3 | | | 22 | 1.3 | | | | .1 | |
| 8 | | | | | .2 | | 23 | | 1.0 | .3 | | | .05 |
| 9 | | | .5 | | | .05 | 25 | | | | .45 | .1 | |
| 10 | | 1.1 | | .5 | | | 26 | 1.0 | 1.0 | | | | |
| 11 | | | | | .2 | | 27 | | | .3 | | | .05 |
| 12 | | (a) | | | | | 28 | | | | .45 | | |
| 13 | | | .45 | | | .05 | 29 | 1.0 | | | | .0 | |
| 15 | 1.3 | | | | | | 30 | | .9 | .3 | | | .25 |

[a] Dry.

### FARMERS AND CITIZENS DITCH NEAR JOSEPH, OREG.

This ditch diverts water from the right bank of Wallowa River a few hundred feet below the head of the Silver Lake ditch.

The gage is vertical and is attached to the left side of the flume near the lower end.

The zero of the gage is the bottom of the flume. The gage was read twice a week by F. L. Bedingfield.

*Discharge measurements of Farmers and Citizens ditch near Joseph, Oreg., in 1905.*

| Date. | Hydrographer. | Width | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 11 | W. C. Sawyer | 11.4 | 22.4 | 3.06 | 1.93 | 68.5 |
| November 27 | R. S. Hall | 11.8 | 10.0 | 1.12 | .75 | 11.2 |

*Daily gage height, in feet, of Farmers and Citizens ditch near Joseph, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 0.65 | | 16 | | 1.5 | 0.8 | | | 0.5 |
| 2 | | 1.9 | 0.9 | | | 0.5 | 18 | | | | 0.7 | 0.6 | |
| 4 | | | | 0.7 | .7 | | 19 | 2.0 | 1.4 | | | | |
| 5 | | 1.9 | | | | | 20 | | | .8 | | | |
| 6 | | | .9 | | | .5 | 21 | | | | .7 | | |
| 7 | | | | .75 | | | 22 | 2.1 | | | | .7 | |
| 8 | | | | | .7 | | 23 | | 1.0 | .6 | | | .55 |
| 9 | | | .85 | | | .5 | 25 | | | | .7 | .5 | |
| 10 | | 1.9 | | .7 | | | 26 | .3 | .9 | | | | |
| 11 | | | | | .65 | | 27 | | | .6 | | | .5 |
| 12 | | 1.8 | | | | | 28 | | | | .65 | | |
| 13 | | | .85 | | | .5 | 29 | 1.7 | | | | .75 | |
| 15 | 1.9 | | | | | | 30 | | .9 | .7 | | | .4 |

### GRANGER DITCH AT JOSEPH, OREG.

This ditch diverts water from the right bank of Wallowa River in the upper part of Joseph.

The gage is a vertical rod attached to the lower side of a wagon bridge a short distance below the lower end of the flume.

Gagings were made from this bridge.

*Discharge measurements of Granger ditch at Joseph, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 12 | W. C. Sawyer | 12.5 | 20.6 | 3.73 | 1.34 | 76.9 |
| November 27 | R. S. Hall | 13.8 | 9.4 | .98 | .30 | 9.1 |

*Daily gage height, in feet, of Granger ditch at Joseph, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 0.4 | | 16 | | 0.5 | 0.4 | | | 0.25 |
| 2 | | 2.2 | 0.4 | | | 0.3 | 18 | | | | 0.5 | 0.4 | |
| 4 | | | | 0.5 | .4 | | 19 | 0.6 | .4 | | | | |
| 5 | | 1.0 | | | | | 20 | | | .35 | | | |
| 6 | | | .4 | | | | 21 | | | | .5 | | |
| 7 | | | | .55 | | | 22 | 1.7 | | | | .4 | |
| 8 | | | | | .4 | | 23 | | .5 | .5 | | | .25 |
| 9 | | | .4 | | | .3 | 25 | | | | .5 | .35 | |
| 10 | | .4 | | .55 | | | 26 | 1.8 | .4 | | | | |
| 11 | | | | | .35 | | 27 | | | .6 | | | .25 |
| 12 | | .9 | | | | | 28 | | | | .4 | | |
| 13 | | | .4 | | | .3 | 29 | 1.8 | | | | .35 | |
| 15 | 1.0 | | | | | | 30 | | .35 | .5 | | | .25 |

### BIG BEND DITCH AT JOSEPH, OREG.

This ditch diverts water from the right bank of Wallowa River in the upper part of Joseph.

The gage is attached to the side of the flume near the lower end. The zero of the gage is the bottom of the flume.

Gagings were made from the wagon bridge below the end of the flume.

*Discharge measuzements of Big Bend ditch at Joseph, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 12 | W. C. Sawyer | 15.0 | 21.2 | 3.43 | 1.10 | 72.7 |
| November 27 | R. S. Hall | 12.5 | 5.2 | 1.57 | .40 | 8.2 |

*Daily gage height, in feet, of Big Bend ditch at Joseph, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 |  |  |  |  | 0.5 |  | 16 |  | 0.25 | .25 |  |  | 0.4 |
| 2 |  | 1.2 | 0.35 |  |  | 0.2 | 18 |  |  |  | 0.5 | 0.6 |  |
| 4 |  |  |  | 0.3 | .6 |  | 19 | 0.8 | .3 |  |  |  |  |
| 5 |  | .7 |  |  |  |  | 20 |  |  | .55 |  |  |  |
| 6 |  |  | .35 |  |  | .3 | 21 |  |  |  | .5 |  |  |
| 7 |  |  |  | .4 |  |  | 22 | 1.1 |  |  |  | .0 |  |
| 8 |  |  |  |  | .6 |  | 23 |  | .2 | 0.6 |  |  | .3 |
| 9 |  |  | .35 |  |  | .3 | 25 |  |  |  | .45 | .65 |  |
| 10 |  | .3 |  | .5 |  |  | 26 | .9 | .2 |  |  |  |  |
| 11 |  |  |  |  | .45 |  | 27 |  |  | .7 |  |  | .25 |
| 12 |  | .5 |  |  |  |  | 28 |  |  |  | .45 |  |  |
| 13 |  |  | .5 |  |  | .3 | 29 | .9 |  |  |  | .3 |  |
| 15 | 0.9 |  |  |  |  |  | 30 |  | .3 | .55 |  |  | .25 |

## COMPANY DITCH NEAR WALLOWA, OREG.

This ditch diverts the water from the right bank of Wallowa River about 1,000 feet above the river gaging station.

The gage is a vertical rod on the right bank nearly opposite the river gaging station.

Gagings were made from the bridge at the gage.

*Discharge measurements of Company ditch near Wallowa, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
|  |  | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 19 | W. C. Sawyer | 13.8 | 1.78 | 2.60 | 24.6 |
| July 8 | do | 10.8 | 1.09 | 2.15 | 11.8 |
| September 18 | do | 8.3 | .77 | 1.82 | 6.4 |
| November 28 | R. S. Hall | 7.6 | 1.03 | 1.90 | 7.8 |

*Daily gage heights, in feet, of Company ditch near Wallowa, Oreg., for 1905.*

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 2 |  |  |  |  |  | 1.9 |  |  |
| 3 |  |  |  |  |  |  | 2.0 |  |
| 4 |  |  |  |  |  |  |  | 1.9 |
| 6 |  |  |  |  |  | 1.85 | 1.95 |  |
| 8 |  |  | 2.15 |  |  |  |  | 1.9 |
| 9 |  |  |  | 1.7 |  | 2.0 |  |  |
| 10 |  |  |  |  |  |  | 1.95 |  |
| 11 |  |  |  |  |  |  |  | 1.7 |
| 13 |  |  |  |  |  | 2.0 | 1.9 |  |
| 15 |  |  |  |  | 1.7 |  |  |  |
| 16 |  |  |  |  |  | 2.1 |  |  |
| 17 |  |  |  |  |  |  | 1.85 |  |
| 18 |  |  |  |  | 1.82 |  |  | 1.8 |
| 19 | 2.6 |  |  |  |  |  |  |  |
| 20 |  |  |  |  |  | 2.0 | 1.95 |  |
| 22 |  |  |  |  | 1.8 |  |  |  |

*Daily gage heights, in feet, of Company ditch near Wallowa, Oreg., for 1905*—Continued.

| Day. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|
| 23 | | | | | | 2.0 | | |
| 24 | | | | | | | 1.8 | |
| 25 | | | | | 1.75 | | | |
| 27 | | | | | | 2.05 | 2.0 | |
| 28 | | | | | | | 1.9 | |
| 29 | | | | | 2.0 | | | |
| 30 | | | | | | 2.0 | | |

*Estimated monthly discharge of Company ditch near Wallowa, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| May (22 days) | 25 | 25 | 25.0 | 1,091 |
| June | 35 | 35 | 35.0 | 2,083 |
| July | 20 | 6 | 11.5 | 707 |
| August | 8 | 5 | 5.55 | 341 |
| September | 9 | 5 | 5.9 | 351 |
| October | 11 | 7 | 8.87 | 545 |
| November | 9 | 6 | 7.93 | 472 |
| December | 12 | 5 | 7.32 | 450 |
| The period | | | | 6,040 |

NOTE.—Discharge estimated between May 10 and September 15.

## ASOTIN CREEK 1½ MILES ABOVE ASOTIN, WASH.

This station was established March 26, 1904, by W. W. Schlecht. It is located at the highway bridge about 1½ miles above Asotin, Wash., at the power house of the Lewiston Water and Power Company.

The channel is straight for about 120 feet above and 40 feet below the station, and the current is swift. Both banks are low and liable to overflow during extreme high water. They are both lined with brush, the left bank being covered with orchards and houses. The bed of the stream is composed of gravel and bowlders and is free from vegetation and fairly permanent. There is one channel at low and two channels at high stages.

Discharge measurements are made from the single-span bridge, to which the gage is attached. The initial point for soundings is a 20-penny nail driven into the floor of the bridge over the mean edge of the left abutment, and marked zero. At low water the current near the right bank may flow diagonally toward the center of the stream; at such times it is advisable to make the measurements from the upstream side of the bridge. During high stages the water at the upstream side is too swift for accurate measurements.

A staff gage is fastened vertically to the downstream face of the left abutment. During 1905 the gage was read once each day by M. E. Turner. Bench marks were established as follows: (1) A 20-penny nail driven horizontally into the guy pole for the chimney of the Lewiston Water and Power Company's power house, between the power house and the bridge, marked "U. S. G. S. B. M.;" elevation, 6.44 feet. (2) A 20-penny nail driven vertically into the stump of an old telegraph pole on the south side of the road, about 100 feet from the bridge, marked "U. S. G. S. B. M.;" elevation, 7.57 feet. Elevations refer to the datum of the gage.

A description of this station and gage height and discharge data are contained in Water-Supply Paper No. 135, United States Geological Survey, pages 237–239.

*Daily gage height, in feet, of Asotin Creek 1¼ miles above Asotin, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.4 | 2.3 | 2.7 | 3.1 | 3.2 | 3.1 | 2.8 | 2.1 | 2.2 | 2.4 | 2.4 | 2.4 |
| 2 | 2.3 | 2.3 | 2.7 | 3.0 | 3.2 | 3.1 | 2.8 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 3 | 2.3 | 2.3 | 2.8 | 3.0 | 3.3 | 3.4 | 2.7 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 4 | 2.3 | 2.3 | 2.8 | 3.0 | 3.3 | 3.3 | 2.7 | 2.1 | 2.2 | 2.4 | 2.4 | 2.4 |
| 5 | 2.3 | 2.3 | 2.8 | 3.0 | 3.2 | 3.3 | 2.7 | 2.1 | 2.2 | 2.4 | 2.4 | 2.4 |
| 6 | 2.3 | 2.3 | 2.8 | 3.0 | 3.2 | 3.3 | 2.7 | 2.1 | 2.3 | 2.4 | 2.4 | 3.4 |
| 7 | 2.3 | 2.3 | 2.8 | 3.1 | 3.2 | 3.2 | 2.6 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 8 | 2.3 | 2.3 | 2.8 | 3.1 | 3.2 | 3.2 | 2.6 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 9 | 2.3 | 2.3 | 2.8 | 3.2 | 3.3 | 3.2 | 2.5 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 10 | 2.2 | 2.3 | 2.8 | 3.2 | 3.3 | 3.2 | 2.4 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 11 | 2.2 | 2.0 | 2.8 | 3.1 | 3.3 | 3.1 | 2.4 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 12 | 2.3 | 2.0 | 2.8 | 3.1 | 3.3 | 3.4 | 2.4 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 13 | 2.3 | 2.8 | 2.8 | 3.1 | 3.3 | 3.1 | 2.3 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 14 | 2.4 | 2.8 | 2.8 | 3.1 | 3.3 | 3.0 | 2.3 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 15 | 2.3 | 2.8 | 2.8 | 3.1 | 3.3 | 2.9 | 2.2 | 2.1 | 2.3 | 2.4 | 2.4 | 2.4 |
| 16 | 2.3 | 2.9 | 2.8 | 3.1 | 3.2 | 2.9 | 2.2 | 2.1 | 2.4 | 2.4 | 2.4 | 2.4 |
| 17 | 2.3 | 2.9 | 2.8 | 3.1 | 3.3 | 2.8 | 2.2 | 2.2 | 2.4 | 2.4 | 2.4 | 2.4 |
| 18 | 2.3 | 3.0 | 3.0 | 3.1 | 3.3 | 2.8 | 2.2 | 2.3 | 2.4 | 2.4 | 2.4 | 2.4 |
| 19 | 2.3 | 2.9 | 3.0 | 3.1 | 3.2 | 2.8 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 20 | 2.2 | 3.1 | 3.0 | 3.3 | 3.2 | 2.7 | 2.2 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 21 | 2.2 | 3.1 | 3.0 | 3.2 | 3.2 | 2.7 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 22 | 2.2 | 2.7 | 3.0 | 3.2 | 3.2 | 2.6 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 23 | 2.2 | 2.6 | 3.0 | 3.2 | 3.2 | 2.7 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 24 | 2.4 | 2.6 | 3.0 | 3.3 | 3.1 | 2.8 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 25 | 2.3 | 2.6 | 3.0 | 3.3 | 3.1 | 2.9 | 2.1 | 2.3 | 2.3 | 2.4 | 2.4 | 2.4 |
| 26 | 2.3 | 2.6 | 3.3 | 3.3 | 3.1 | 3.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.4 | 2.4 |
| 27 | 2.3 | 2.7 | 3.2 | 3.2 | 3.1 | 3.0 | 2.1 | 2.2 | 3.1 | 2.4 | 2.4 | 2.4 |
| 28 | 2.3 | 2.7 | 3.2 | 3.2 | 3.1 | 3.0 | 2.1 | 2.2 | 2.7 | 2.4 | 2.4 | 2.4 |
| 29 | 2.3 | ....... | 3.2 | 3.2 | 3.1 | 2.8 | 2.1 | 2.2 | 2.5 | 2.4 | 2.4 | 2.4 |
| 30 | 2.3 | ....... | 3.2 | 3.2 | 3.1 | 2.8 | 2.1 | 2.2 | 2.5 | 2.4 | 2.4 | 2.4 |
| 31 | 2.3 | ....... | 3.1 | ....... | 3.1 | ....... | 2.1 | 2.2 | ....... | 2.4 | 2.4 | 2.4 |

NOTE.—No ice record.

## ASOTIN CREEK AT SHELMAN'S RANCH, NEAR ASOTIN, WASH.

This station was established March 25, 1904, by W. W. Schlecht. It is located at Shelman's ranch, about 8 miles above Asotin, Wash. The station is 50 feet above the headgate of Shelman's irrigation ditch.

The channel is straight for about 100 feet above and below the station and the current is swift. The right bank is a flood plain about 350 feet wide, which may be flooded at extreme high water. The left bank is a similar plain about 120 feet wide, which overflows during high water. Both banks are lined with trees and brush. The bed of the stream is composed of gravel and bowlders and is free from vegetation and fairly permanent. There is one channel at ordinary and two at extreme high stages.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is a nail driven into a hub below the cable support on the left bank.

A staff gage is fastened to a tree on the left bank. During 1905 the gage was read once each day by J. W. Whittaker. The bench mark is the top of a 40-penny nail driven horizontally into a large willow tree about 40 feet west of Shelman's house, 2 feet north of the road, marked "U. S. G. S. B. M.;" elevation, 10.00 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 239–240.

*Daily gage height, in feet, of Asotin Creek at Shelman's ranch, near Asotin, Wash., for 1905.*

| Day. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 1.82 | 1.85 | 1.7 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 2 | 1.7 | 1.78 | 1.92 | 1.65 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 3 | 1.7 | 1.8 | 2.6 | 1.62 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 4 | 1.65 | 1.8 | 2.5 | 1.65 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 5 | 1.65 | 1.8 | 2.47 | 1.62 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 6 | 1.65 | 1.8 | 2.45 | 1.6 | 1.45 | 1.45 | 1.5 | 1.45 | 1.5 |
| 7 | 1.75 | 1.8 | 2.45 | 1.55 | 1.45 | 1.45 | 1.5 | 1.45 | 1.5 |
| 8 | 1.75 | 1.8 | 2.45 | 1.55 | 1.45 | 1.45 | 1.5 | 1.48 | 1.5 |
| 9 | 1.77 | 1.8 | 2.42 | 1.55 | 1.45 | 1.45 | 1.5 | 1.5 | 1.45 |
| 10 | 1.75 | 1.82 | 2.38 | 1.55 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 11 | 1.75 | 1.85 | 2.35 | 1.55 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 12 | 1.75 | 1.8 | 2.5 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 13 | 1.75 | 1.8 | 2.5 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 14 | 1.7 | 1.8 | 2.45 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 15 | 1.72 | 1.82 | 2.4 | 1.5 | 1.45 | 1.45 | 1.5 | 1.45 | 1.5 |
| 16 | 1.7 | 1.85 | 2.37 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 17 | 1.7 | 1.9 | 2.27 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 18 | 1.7 | 1.9 | 2.25 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 19 | 1.8 | 1.9 | 2.25 | 1.5 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 |
| 20 | 1.8 | 1.9 | 2.25 | 1.5 | 1.45 | 1.45 | 1.5 | 1.45 | 1.5 |
| 21 | 1.82 | 1.85 | 2.25 | 1.5 | 1.45 | 1.45 | 1.5 | 1.48 | 1.45 |
| 22 | 1.82 | 1.85 | 2.25 | 1.45 | 1.45 | 1.45 | 1.5 | 1.5 | 1.45 |
| 23 | 1.8 | 1.85 | 2.25 | 1.45 | 1.45 | 1.45 | 1.5 | 1.5 | 1.45 |
| 24 | 1.82 | 1.8 | 2.25 | 1.45 | 1.45 | 1.45 | 1.5 | 1.5 | 1.45 |
| 25 | 1.85 | 1.8 | 2.62 | 1.45 | 1.45 | 1.45 | 1.55 | 1.5 | 1.45 |
| 26 | 1.85 | 1.8 | 1.82 | 1.45 | 1.45 | 1.5 | 1.5 | 1.5 | 1.55 |
| 27 | 1.85 | 1.75 | 2.25 | 1.45 | 1.45 | 1.65 | 1.5 | 1.5 | 1.5 |
| 28 | 1.85 | 1.8 | 1.7 | 1.45 | 1.45 | 1.6 | 1.5 | 1.5 | 1.5 |
| 29 | 1.85 | 1.85 | 1.72 | 1.45 | 1.45 | 1.5 | 1.55 | 1.5 | 1.5 |
| 30 | 1.85 | 1.85 | 1.6 | 1.45 | 1.45 | 1.5 | 1.55 | 1.5 | 1.5 |
| 31 | ........ | 1.85 | ........ | 1.45 | 1.45 | ........ | 1.5 | ........ | 1.45 |

## PALOUSE RIVER AT ELBERTON, WASH.

This station was established May 6, 1904, by W. G. Steward, and was discontinued September 30, 1905, owing to changes in the dam near by. It is located at the highway bridge about one-half mile above the depot in Elberton, Wash.

The west channel is straight for about 1,500 feet above and below the station. The current is swift. The east channel leaves the main (west) channel about 150 feet above the station and makes a reverse curve, striking the bridge at an angle of about 30°. The east channel is straight for 300 feet below and curved above the station. At high water the current is swift; at low water there is no flow in this channel. The right bank is high and not liable to overflow except in case of extreme high water, in which case the town would be flooded. The left bank is low and overflows during high water along the roadway to the east of the east channel. The bed of the stream is composed of rock and gravel, is free from vegetation, and is shifting. All the water flows in one channel at low and in two at high stages.

Discharge measurements are made for the west channel from the upstream side of the bridge. For the east channel measurements are made from the downstream side of the bridge. The initial point for the west channel is a point on the guard rail immediately above the face of the left abutment. The initial point for the east channel is the left end of the downstream hand rail. Both initial points are marked zero with nails and black paint.

A staff gage is fastened vertically to the south end of the face of the left abutment of the bridge. During 1905 the gage was read once each day by W. B. Peoples. Bench marks were established as follows: (1) A 20-penny nail in a large white post on the south side of the railroad track, about one-fourth mile east of the depot; elevation, 2,198.05 feet above sea level and 5.80 feet above the datum of the gage. (2) A square black-paint mark on the southeast window sill of the hotel; elevation, 2,203.91 feet above sea level and 11.66 feet above the datum of the gage. (3) The head of a rivet in the base of the bridge truss at the southwest corner of the bridge, painted "U. S. G. S." on the plate; elevation, 2,206.01 feet above sea level and 13.76 feet above the datum of the gage.

May 24, 1905, a discharge measurement made at this station by W. J. Lightfoot gave the following results: Width, 68 feet; area of section, 116 square feet; mean velocity, 1.93 feet per second; gage height, 2.3 feet; discharge, 224 second-feet.

A description of this station, with gage heights, discharge data, and rating table, is contained in Water-Supply Paper No. 135, United States Geological Survey, pages 240–243.

*Daily gage height, in feet, of Palouse River at Elberton, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.7 | 1.8 | 2.0 | 2.3 | 2.0 | 2.2 | 1.6 | 0.8 | 0.7 |
| 2 | 1.9 | 1.8 | 2.2 | 2.10 | 1.9 | 2.0 | 1.6 | 1.0 | .7 |
| 3 | 1.8 | 1.8 | 2.0 | 2.0 | 2.0 | 1.5 | 1.6 | .9 | .7 |
| 4 | 1.7 | 1.8 | 1.9 | 2.5 | 2.0 | 2.3 | 1.4 | .8 | .7 |
| 5 | 1.6 | 1.8 | 2.7 | 2.2 | 1.9 | 3.0 | 1.1 | .8 | .7 |
| 6 | 2.0 | 1.8 | 1.7 | 2.0 | 1.4 | 2.7 | 1.1 | .8 | .7 |
| 7 | 1.9 | 1.9 | 2.6 | 1.7 | 1.3 | 3.5 | 2.1 | .7 | .7 |
| 8 | 1.7 | 1.8 | 2.0 | 2.4 | 1.9 | 3.0 | 1.3 | .7 | .7 |
| 9 | 1.7 | 1.8 | 1.8 | 2.3 | 1.4 | 2.9 | 1.5 | .7 | .7 |
| 10 | 1.7 | 1.7 | 2.0 | 2.3 | 1.9 | 2.6 | 1.3 | 1.2 | .7 |
| 11 | 1.7 | 1.6 | 2.6 | 2.3 | 1.4 | 2.4 | 1.1 | .9 | .7 |
| 12 | 1.7 | 1.6 | 1.7 | 2.3 | 2.2 | 2.3 | 1.4 | .7 | .7 |
| 13 | 1.6 | 1.6 | 1.7 | 2.4 | 2.5 | 2.2 | 1.1 | .8 | .7 |
| 14 | 1.6 | 1.6 | 2.0 | 2.0 | 2.0 | 2.0 | .9 | .7 | .7 |
| 15 | 1.6 | 1.6 | 1.7 | 1.7 | 2.0 | 2.0 | 1.2 | .7 | .8 |
| 16 | 1.7 | 1.6 | 1.7 | 2.5 | 2.0 | 1.9 | 1.0 | .7 | .8 |
| 17 | 1.6 | 1.6 | 1.8 | 1.7 | 2.0 | 1.3 | 1.0 | .7 | .8 |
| 18 | 1.5 | 1.6 | 2.7 | 1.8 | 2.0 | 1.6 | 1.4 | 1.0 | .8 |
| 19 | 1.7 | 1.6 | 1.9 | 2.4 | 1.5 | 1.2 | 1.1 | .8 | .9 |
| 20 | 1.7 | 1.6 | 1.7 | 3.5 | 2.3 | 2.15 | 1.0 | .5 | .8 |
| 21 | 1.6 | 1.6 | 3.3 | 3.6 | 2.0 | 1.8 | 1.1 | .7 | .8 |
| 22 | 1.6 | 1.8 | 1.6 | 2.0 | 2.2 | 1.2 | 1.1 | .7 | .9 |
| 23 | 1.7 | 1.8 | 2.6 | 2.4 | 2.3 | 1.2 | .8 | .7 | 1.5 |
| 24 | 1.9 | 1.8 | 1.8 | 2.0 | 2.3 | 1.6 | 1.2 | .7 | 1.4 |
| 25 | 1.8 | 1.8 | 3.7 | 2.7 | 2.9 | 1.1 | 1.0 | .6 | 1.4 |
| 26 | 1.8 | 2.0 | 2.9 | 2.3 | 3.3 | 1.2 | 1.3 | .6 | 1.4 |
| 27 | 1.9 | 2.2 | 3.7 | 2.4 | 2.9 | 1.8 | 1.1 | .6 | 1.3 |
| 28 | 1.9 | 2.0 | 2.7 | 2.2 | 1.8 | 2.0 | 1.1 | 1.1 | 1.2 |
| 29 | 1.9 | ........ | 3.0 | 2.0 | 2.8 | 1.8 | .9 | .9 | 1.0 |
| 30 | 2.0 | ........ | 2.5 | 2.0 | 2.5 | 1.7 | .9 | .9 | 1.0 |
| 31 | 2.0 | ........ | 2.4 | ........ | 2.5 | ........ | .9 | .8 | ........ |

NOTE.—Sudden changes are due to flow being controlled by dam.

## PALOUSE RIVER AT HOOPER, WASH.

The headwater tributaries of this river have their sources in western Idaho. After reaching Washington they unite to form Palouse River, which flows in a general southwesterly direction through a rolling country. Six miles below Hooper, Wash., the river bends suddenly to the south and enters its canyon, through which it flows to its junction with Snake River. For some distance above Hooper the river consists of a succession of pools from 10 to 15 feet in depth, connected by short riffles. Its valley is about one-half mile in width and bordered with basaltic cliffs approximately 300 feet in height. A short distance above the mouth of the river are the Palouse Falls, which are approximately 130 feet in height.

The measurements of Palouse River are of value in showing the amount of water that could be utilized for irrigation on lands of Washtucna Valley and in the section north of Pasco.

The gaging station at Hooper, Wash., was originally established April 1, 1897, by the land department of the Northern Pacific Railway. The United States Geological Survey assumed charge September 9, 1897, and moved the station about 1 mile downstream.

The channel is straight for 200 feet above and one-fourth of a mile below the cable. The current is swift. The left bank is high and can not overflow. The right bank overflows during high stages of the river. Both banks are covered with brush. The bed of the stream is rocky and free from vegetation, but bowlders in the bed make it difficult to obtain accurate results at this point at low water. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the cable post on the left bank.

Owing to various conditions it has been necessary to use several gages, all having the same datum. The present gage, known as gage No. 4, is in two sections. The lower section is inclined, the upper is vertical. During 1905 the gage was read once each day by Frank Hill. Bench marks were established as follows: (1) The highest point on a ledge of rock on the left bank 200 feet below the cable; elevation, 7.60 feet. (2) The top of a large rock on the right bank 250 feet west of the cable post and 115 feet from the water's edge; elevation, 10.88 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):

Description: WS 16, p 172; 28, p 155; 38, pp 360-361; 51, p 443; 66, p 136; 85, pp 203-204; 100, pp 413-414; 135, pp 243-244.

Discharge: Ann 19, iv, p 460; WS 16, p 172; 28, p 168; 51, p 444; 85, p 204; 100, p 414; 135, p 245.

Discharge, monthly: Ann 20, iv, pp 489, 514; 21, iv, p 414; 22, iv, p 452; WS 75, p 206; 85, p 205; 135. p. 247.

Discharge, yearly: Ann 20, iv, p 62.

Gage heights: WS 16, p 172; 28, p 162; 38, p 361; 51, p 444; 66, p 137; 85, p 204; 100, p 415; 135, pp 245-246,

Hydrographs: Ann 20, iv, p 490; 21, iv, p 415; 22, iv, p 452.

Rainfall and run-off relation: Ann 20, iv, p 514.

Rating tables. WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 85, p 205; 135, p 246.

*Discharge measurements of Palouse River at Hooper, Wash., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square-feet* | *Feet per second* | *Feet.* | *Second-feet.* |
| May 18 | W. J. Lightfoot | 84 | 153 | 1.72 | 2.30 | 264 |
| November 23 | W. C. Sawyer | 66 | 74 | .74 | 1.13 | 55 |

*Daily gage height, in feet, of Palouse River at Hooper, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 2.55 | 2.5 | 3.8 | 2.4 | 2.75 | 1.85 | 0.85 | 0.65 | 0.8 | 1.3 | 1.45 |
| 2 | 2.0 | 3.0 | 2.5 | 3.8 | 2.3 | 2.45 | 1.85 | .85 | .65 | .95 | 1.1 | 2.35 |
| 3 | 1.75 | 2.2 | 2.45 | 3.4 | 2.3 | 2.6 | 1.8 | .85 | .65 | 1.0 | 1.35 | 1.95 |
| 4 | 1.7 | 2.7 | 2.4 | 2.85 | 2.3 | 2.4 | 1.75 | .8 | .65 | 1.0 | 1.3 | 1.65 |
| 5 | 2.05 | 2.45 | 2.3 | 3.1 | 2.25 | 2.0 | 1.6 | .8 | .6 | 1.0 | 1.4 | 1.45 |
| 6 | 1.75 | 2.3 | 2.15 | 2.9 | 2.2 | 2.55 | 1.55 | .8 | .6 | 1.4 | 1.65 | 1.55 |
| 7 | 1.5 | 2.3 | 2.55 | 2.65 | 2.1 | 3.0 | 1.45 | .8 | .6 | 1.3 | 1.55 | 1.7 |
| 8 | 1.5 | 2.2 | 2.25 | 2.6 | 2.0 | 3.75 | 1.35 | .8 | .6 | 1.6 | 1.45 | 1.6 |
| 9 | 1.5 | 2.1 | 2.65 | 2.65 | 1.85 | 3.35 | 1.35 | .8 | .6 | 1.7 | 1.35 | 2.0 |
| 10 | 1.45 | 2.05 | 2.5 | 2.8 | 2.10 | 3.1 | 1.4 | .8 | .6 | 1.5 | 1.2 | 1.75 |
| 11 | 1.4 | [a] 3.1 | 2.3 | 2.6 | 2.0 | 2.85 | 1.4 | .8 | .6 | 1.5 | 1.2 | 1.55 |
| 12 | 1.4 | 1.8 | 2.3 | 2.55 | 2.1 | 2.7 | 1.3 | .75 | .6 | 1.45 | 1.3 | 1.45 |
| 13 | 1.4 | 1.8 | 2.55 | 2.55 | 2.05 | 2.5 | 1.25 | .75 | .6 | 1.3 | 1.2 | 1.4 |
| 14 | 1.4 | 1.95 | 2.1 | 2.5 | 2.6 | 2.35 | 1.2 | .75 | .65 | 1.4 | 1.2 | 1.4 |
| 15 | 1.3 | 1.9 | 2.4 | 2.5 | 3.0 | 2.3 | 1.2 | .75 | .7 | 1.4 | 1.2 | 1.5 |
| 16 | 1.3 | 1.95 | 2.15 | 2.2 | 2.6 | 2.15 | 1.2 | .75 | .7 | 1.4 | 1.4 | 1.5 |
| 17 | 1.45 | 1.9 | 2.45 | 2.15 | 3.1 | 2.05 | 1.2 | .75 | .7 | 1.35 | 1.5 | 1.6 |
| 18 | 1.5 | 1.95 | 2.1 | 2.55 | 2.3 | 2.0 | 1.15 | .75 | .7 | 1.35 | 1.4 | 1.75 |
| 19 | 1.5 | 1.9 | 2.05 | 2.25 | 2.95 | 1.75 | 1.15 | .75 | .7 | 1.3 | 1.35 | 1.65 |
| 20 | 1.5 | 2.0 | 2.6 | 2.35 | 2.2 | 1.95 | 1.15 | .75 | .7 | 1.3 | 1.3 | 1.8 |
| 21 | 1.5 | 1.95 | 2.35 | 2.65 | 1.9 | 1.70 | 1.1 | .75 | .7 | 1.3 | 1.25 | 1.75 |
| 22 | 1.5 | 1.95 | 2.8 | 2.95 | 2.3 | 1.55 | 1.1 | .7 | .7 | 1.7 | 1.2 | 1.75 |
| 23 | 1.6 | 2.05 | 2.8 | 2.95 | 2.95 | 2.05 | 1.1 | .7 | .7 | 1.5 | 1.1 | 1.7 |
| 24 | 2.45 | 2.15 | 2.5 | 3.75 | 2.35 | 1.70 | 1.05 | .7 | .7 | 1.4 | 1.25 | 1.6 |
| 25 | 3.45 | 2.45 | 2.6 | 3.3 | 2.45 | 1.6 | 1.05 | .7 | .7 | 1.3 | 1.35 | 1.95 |
| 26 | 3.0 | 2.4 | 2.75 | 3.2 | 2.5 | 2.15 | 1.0 | .7 | .7 | 1.2 | 1.35 | 1.8 |
| 27 | 2.75 | 2.4 | 3.3 | 3.2 | 3.45 | 1.8 | 1.9 | .7 | .75 | 1.2 | 1.25 | 2.0 |
| 28 | 2.7 | 2.45 | 4.2 | 2.6 | 3.25 | 1.65 | .85 | .7 | .75 | 1.5 | 1.2 | 1.7 |
| 29 | 2.85 | ....... | 4.2 | 2.5 | 3.25 | 2.0 | .85 | .65 | .75 | 1.65 | 1.35 | 1.5 |
| 30 | 2.8 | ....... | 4.1 | 2.45 | 2.6 | 1.7 | .85 | .65 | .75 | 1.4 | 1.4 | 1.6 |
| 31 | 2.7 | ....... | 3.7 | ....... | 2.6 | ....... | .85 | .65 | ....... | 1.35 | ....... | 1.5 |

[a] Backwater from ice gorge.

*Station rating table for Palouse River at Hooper, Wash., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.60 | 19 | 1.60 | 116 | 2.50 | 296 | 3.40 | 540 |
| 0.70 | 24 | 1.70 | 132 | 2.60 | 320 | 3.50 | 570 |
| 0.80 | 30 | 1.80 | 150 | 2.70 | 344 | 3.60 | 602 |
| 0.90 | 36 | 1.90 | 168 | 2.80 | 370 | 3.70 | 634 |
| 1.00 | 44 | 2.00 | 188 | 2.90 | 396 | 3.80 | 666 |
| 1.10 | 52 | 2.10 | 208 | 3.00 | 424 | 3.90 | 700 |
| 1.20 | 62 | 2.20 | 228 | 3.10 | 452 | 4.00 | 734 |
| 1.30 | 74 | 2.30 | 250 | 3.20 | 480 | 4.10 | 768 |
| 1.40 | 88 | 2.40 | 272 | 3.30 | 510 | 4.20 | 802 |
| 1.50 | 102 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5. It is not well defined.

*Estimated monthly discharge of Palouse River at Hooper, Wash., for 1905.*

[Drainage area, 2,210 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet. | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| January | 555 | 74 | 181 | 11,130 | 0.082 | 0.094 |
| February | 424 | 150 | 225 | 12,500 | .102 | .106 |
| March | 802 | 198 | 348 | 21,400 | .157 | .181 |
| April | 666 | 218 | 380 | 22,610 | .172 | .192 |
| May | 555 | 159 | 294 | 18,080 | .133 | .153 |
| June | 650 | 109 | 258 | 15,350 | .117 | .130 |
| July | 159 | 33 | 73.9 | 4,544 | .033 | .038 |
| August | 33 | 22 | 27.2 | 1,672 | .012 | .014 |
| September | 27 | 19 | 22.2 | 1,321 | .010 | .011 |
| October | 132 | 30 | 82.2 | 5,054 | .037 | .043 |
| November | 124 | 52 | 76.9 | 4,576 | .035 | .039 |
| December | 261 | 88 | 126 | 7,747 | .057 | .066 |
| The year | 802 | 19 | 175 | 126,000 | .079 | 1.07 |

NOTE.—Owing to backwater February 11, the discharge was interpolated between the discharges for February 10 and 12.

## ROCK CREEK NEAR ST. JOHN, WASH.

This station was established October 15, 1903, by G. H. Bliss, and discontinued September 30, 1905. It is located at the highway bridge which crosses Rock Creek at the outlet of Rock Lake, three-fourths of a mile from the ranch of the observer, C. K. Reimer. It is 9 miles northeast of St. John, Whitman County, Wash.

The channel is straight for 200 feet above and 75 feet below the station. The current is sluggish at the bridge at low stages. Both banks are low and rocky and liable to overflow at flood stages. The bed of the stream is covered with rocks and gravel and is liable to shift at flood stages.

At high stages discharge measurements are made from the downstream side of the highway bridge. At low stages they are made by wading below the bridge. The bridge is supported by pile bents and has a total span of 210 feet. The initial point for soundings is the end post of the downstream handrail.

The gage is a vertical rod fastened to the fifth pile bent of the southeast (left) bank approach. Bench marks were established as follows: (1) A spike driven into the downstream side of the top of the sill of the third pile bent from the left-bank approach; elevation, 12.52 feet. (2) The top of a large rock on a point of rocks on the southeast side of the lake about 3,000 feet above the outlet; elevation, 16.70 feet. Elevations refer to the datum of the gage.

May 20, 1905, a discharge measurement made at this station by W. J. Lightfoot gave the following results: Width, 111 feet; area of section, 76 square feet; mean velocity, 0.29 foot per second; gage height, 10.8 feet; discharge, 22 second-feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey.

Description: 100, pp 415-416; 135, pp 247-248.
Discharge: 100, p 416; 135, p 248.
Discharge, monthly: 135, p 249.
Gage heights: 100, p 416; 135, p 248.
Rating table: 135, p 249.

*Daily gage height, in feet, of Rock Creek near St. John, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 10.54 | 12.05 | 11.42 | 11.38 | 11.18 | 10.8 | 10.72 | 10.34 | 9.9 |
| 2 | 10.6 | 11.95 | 11.42 | 11.38 | 11.18 | 10.8 | 10.72 | 10.32 | 9.9 |
| 3 | 10.6 | 11.95 | 11.4 | 11.38 | 11.16 | 10.85 | 10.7 | 10.3 | 9.88 |
| 4 | 10.62 | 11.95 | 11.4 | 11.38 | 11.16 | 10.85 | 10.7 | 10.28 | 9.88 |
| 5 | 10.62 | 11.9 | 11.4 | 11.38 | 11.16 | 10.85 | 10.68 | 10.26 | 9.86 |
| 6 | 10.65 | 11.85 | 11.4 | 11.38 | 11.16 | 10.85 | 10.68 | 10.24 | 9.86 |
| 7 | 10.65 | 11.8 | 11.38 | 11.38 | 11.14 | 10.85 | 10.65 | 10.22 | 9.84 |
| 8 | 10.65 | 11.75 | 11.38 | 11.38 | 11.14 | 10.82 | 10.65 | 10.2 | 9.84 |
| 9 | 10.68 | 11.75 | 11.38 | 11.35 | 11.12 | 10.82 | 10.62 | 10.18 | 9.82 |
| 10 | 10.68 | 11.75 | 11.38 | 11.35 | 11.12 | 10.8 | 10.62 | 10.16 | 9.82 |
| 11 | 10.68 | 11.7 | 11.38 | 11.33 | 11.1 | 10.8 | 10.6 | 10.14 | 9.82 |
| 12 | 10.68 | 11.65 | 11.35 | 11.32 | 11.1 | 10.8 | 10.6 | 10.12 | 9.82 |
| 13 | 10.68 | 11.6 | 11.35 | 11.3 | 11.08 | 10.8 | 10.58 | 10.1 | 9.84 |
| 14 | 10.7 | 11.55 | 11.3 | 11.3 | 11.08 | 10.78 | 10.55 | 10.1 | 9.84 |
| 15 | 10.7 | 11.5 | 11.3 | 11.28 | 11.04 | 10.78 | 10.52 | 10.08 | 9.82 |
| 16 | 10.7 | 11.46 | 11.28 | 11.28 | 11.0 | 10.75 | 10.5 | 10.08 | 9.82 |
| 17 | 10.7 | 11.4 | 11.25 | 11.28 | 11.0 | 10.75 | 10.5 | 10.06 | 9.8 |
| 18 | 10.7 | 11.4 | 11.25 | 11.27 | 10.95 | 10.75 | 10.5 | 10.06 | 9.8 |
| 19 | 10.7 | 11.4 | 11.25 | 11.25 | 10.9 | 10.72 | 10.5 | 10.05 | 9.8 |
| 20 | 10.7 | 11.4 | 11.25 | 11.25 | 10.85 | 10.72 | 10.48 | 10.04 | 9.8 |
| 21 | 10.7 | 11.4 | 11.25 | 11.23 | 10.8 | 10.72 | 10.48 | 10.02 | 9.78 |
| 22 | 10.7 | 11.4 | 11.25 | 11.23 | 10.8 | 10.7 | 10.48 | 10.02 | 9.78 |
| 23 | 10.85 | 11.4 | 11.25 | 11.22 | 10.8 | 10.7 | 10.45 | 10.0 | 9.78 |
| 24 | 11.35 | 11.4 | 11.3 | 11.22 | 10.8 | 10.7 | 10.45 | 10.0 | 9.76 |
| 25 | 12.0 | 11.42 | 11.35 | 11.2 | 10.8 | 10.8 | 10.45 | 10.0 | 9.76 |
| 26 | 12.12 | 11.42 | 11.35 | 11.2 | 10.8 | 10.8 | 10.42 | 9.98 | 9.76 |
| 27 | 12.18 | 11.45 | 11.38 | 11.2 | 10.8 | 10.78 | 10.42 | 9.98 | 9.76 |
| 28 | 12.2 | 11.45 | 11.4 | 11.18 | 10.8 | 10.75 | 10.4 | 9.96 | 9.76 |
| 29 | 12.2 | ........ | 11.4 | 11.18 | 10.8 | 10.75 | 10.38 | 9.94 | 9.76 |
| 30 | 12.2 | ........ | 11.4 | 11.18 | 10.8 | 10.74 | 10.38 | 9.92 | 9.76 |
| 31 | 12.15 | ........ | 11.38 | ........ | 10.8 | ........ | 10.36 | 9.92 | ........ |

*Station rating table for Rock Creek near St. John, Wash., from October 15, 1903, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 10.00 | 0.0 | 10.60 | 14 | 11.20 | 59 | 11.80 | 134 |
| 10.10 | .5 | 10.70 | 19 | 11.30 | 70 | 11.90 | 149 |
| 10.20 | 1.5 | 10.80 | 25 | 11.40 | 82 | 12.00 | 165 |
| 10.30 | 3 | 10.90 | 32 | 11.50 | 94 | 12.10 | 183 |
| 10.40 | 6 | 11.00 | 40 | 11.60 | 107 | 12.20 | 203 |
| 10.50 | 10 | 11.10 | 49 | 11.70 | 120 | 14.00 | 940 |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1903-1905. It is well defined.

*Estimated monthly discharge of Rock Creek near St. John, Wash., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 203 | 12 | 59.2 | 3,640 |
| February | 174 | 82 | 110 | 6,109 |
| March | 84 | 64 | 75.2 | 4,624 |
| April | 80 | 57 | 69.0 | 4,106 |
| May | 57 | 25 | 39.6 | 2,435 |
| June | 28 | 19 | 23.7 | 1,410 |
| July | 20 | 5 | 11.8 | 726 |
| August | 4 | 0 | .89 | 55 |
| September | 0 | 0 | .00 | 0 |
| The period | | | | 23,100 |

## COW CREEK NEAR KEYSTONE, WASH.

This station was established November 10, 1904, by Calvin Casteel, and discontinued September 30, 1905. It is located at the highway bridge on the Sprague-Ritzville road crossing of Cow Creek, 2¼ miles east of Keystone, Wash., and one-fourth mile southeast of Lakeview schoolhouse. The station is a short distance below the foot of Colville Lake.

The channel is straight for about 200 feet above and 100 feet below the station. The current above the station is moderate at ordinary and sluggish at low stages; below the station it is swift at all stages. Both banks are high, clean, and not liable to overflow. The bed of the stream is composed of rock and gravel and is permanent. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the single-span bridge. The bridge is 18.6 feet long between abutments. The initial point for soundings is a nail driven into the end of a plank on the deck of the bridge above the edge of the abutment.

A staff gage is fastened vertically to a post of the bridge at the upper left end. During 1905 the gage was read once each day by S. A. Fulquartz. The bench mark is a United States Geological Survey standard aluminum tablet set in a large bowlder, 125 feet up Cow Creek from the Sprague-Ritzville road Crossing, on the right bank; elevation, 1,883.15 feet above sea level and 4.19 feet above the datum of the gage.

May 15, 1905, a discharge measurement made at this station by W. J. Lightfoot gave the following results: Width, 18.6 feet; area of section, 12 square feet; mean velocity, 1.08 feet per second; gage height, 0.90 foot; discharge, 13 second-feet.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, page 250.

*Daily gage height, in feet, of Cow Creek near Keystone, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.87 | 1.25 | 1.06 | 1.01 | 0.9 | 0.76 | 0.65 | 0.27 | 0.0 |
| 2 | .88 | 1.18 | 1.06 | 1.01 | .9 | .74 | .63 | .26 | .0 |
| 3 | .88 | 1.13 | 1.06 | 1.0 | .89 | .78 | .6 | .25 | .0 |
| 4 | .87 | 1.09 | 1.06 | .99 | .89 | .79 | .57 | .24 | .0 |
| 5 | .88 | 1.08 | 1.06 | .98 | .87 | .8 | .55 | .24 | .0 |
| 6 | .89 | 1.06 | 1.05 | .98 | .87 | .81 | .54 | .21 | .0 |
| 7 | .89 | 1.05 | 1.05 | .97 | .88 | .82 | .52 | .18 | .0 |
| 8 | .88 | 1.12 | 1.05 | .97 | .87 | .82 | .51 | .17 | .0 |
| 9 | .88 | 1.15 | 1.05 | .96 | .87 | .81 | .5 | .14 | .0 |
| 10 | .90 | 1.2 | 1.06 | .95 | .88 | .81 | .5 | .12 | .0 |
| 11 | .94 | 1.22 | 1.07 | .95 | .88 | .79 | .48 | .10 | .0 |
| 12 | .98 | 1.1 | 1.09 | .9 | .89 | .75 | .45 | .04 | .0 |
| 13 | .98 | 1.0 | 1.1 | .9 | .89 | .7 | .42 | .02 | .0 |

*Daily gage height, in feet, of Cow Creek near Keystone, Wash., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 0.98 | 1.02 | 1.08 | 0.91 | 0.89 | 0.66 | 0.41 | 0.01 | 0.0 |
| 15 | .98 | 1.01 | 1.05 | .92 | .88 | .66 | .4 | .0 | .0 |
| 16 | .9 | 1.0 | 1.02 | .94 | .88 | .67 | .4 | .0 | .0 |
| 17 | .88 | .98 | 1.0 | .96 | .88 | .67 | .39 | .0 | .0 |
| 18 | .88 | .98 | .99 | .97 | .87 | .66 | .39 | .0 | .0 |
| 19 | .89 | .99 | .99 | .97 | .87 | .66 | .38 | .0 | .0 |
| 20 | .9 | 1.01 | .98 | .97 | .87 | .67 | .37 | .0 | .0 |
| 21 | .91 | 1.02 | .98 | .96 | .84 | .66 | .37 | .0 | .0 |
| 22 | .9 | 1.04 | .99 | .96 | .8 | .67 | .36 | .0 | .0 |
| 23 | .89 | 1.07 | .99 | .97 | .79 | .68 | .35 | .0 | .0 |
| 24 | .89 | 1.07 | .98 | .97 | .79 | .7 | .32 | .0 | .0 |
| 25 | .95 | 1.08 | .98 | .98 | .8 | .68 | .32 | .0 | .0 |
| 26 | 1.0 | 1.07 | .99 | .97 | .79 | .67 | .3 | .0 | .0 |
| 27 | 1.07 | 1.06 | 1.0 | .96 | .78 | .67 | .31 | .0 | .0 |
| 28 | 1.08 | 1.06 | 1.0 | .97 | .78 | .66 | .32 | .0 | .0 |
| 29 | 1.06 | ........ | 1.01 | .98 | .77 | .65 | .33 | .0 | .0 |
| 30 | 1.04 | ........ | 1.01 | .9 | .77 | .65 | .31 | .0 | .0 |
| 31 | 1.25 | ........ | 1.0 | ........ | .76 | ........ | .29 | .0 | .0 |

## WALLA WALLA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Walla Walla River, the drainage basin of which is one of the best irrigated and most productive localities in either Washington or Oregon, enters Columbia River from the east near the town of Wallula, Wash.

### SOUTH FORK OF WALLA WALLA RIVER NEAR MILTON, OREG.

This station was originally established February 15, 1903, 6 miles above the mouth of the river and 12 miles from Milton, Oreg. The gage was read once each day from the date of establishment to October 31, 1903, by N. Redden. As there were no means for making flood measurements at this point, the station was moved to the highway bridge one-fourth mile above the junction of North and South forks, 6 miles from Milton.

The channel is straight for 100 feet above and 150 feet below the bridge. The current is swift. The right bank is low, wooded, and liable to overflow. The left bank is low, but is not liable to overflow, and is without trees. The bed of the stream is composed of gravel, is free from vegetation, and is not liable to shift to any considerable extent.

Discharge measurements are made from the upstream side of the single-span highway bridge one-fourth mile above the mouth of South Fork. The initial point for soundings is the south side of a projecting beam which supports the north end of the lower chord of the bridge. The bridge has a span of 65 feet between abutments.

The gage is a vertical timber, secured to a stump on the right bank three-fourths of a mile above the highway bridge and directly back of the house of the observer, Harry Huber, who, during 1905, read the gage once each day. Bench marks were established as follows: (1) A 20-penny nail driven into a cottonwood tree 1 foot in diameter 15 feet above the gage rod; elevation, 7.00 feet. (2) A 20-penny nail driven into the tree to which the gage is attached; elevation, 7.00 feet. Elevations refer to the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of United States Geological Survey:

Description: 100, p 371; 135, pp 251-252.
Discharge: 100, p 372; 135, p 252.
Discharge, monthly: 135, p 253.
Gage heights: 100, pp 372-373; 135, pp 252-253.
Rating table: 135, p 253.

*Discharge measurements of South Fork of Walla Walla River near Milton, Oreg., for 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 8 | W. C. Sawyer | 40 | 30 | 5.11 | 1.51 | 153 |
| March 18 | H. A. Yates | 47 | 49 | 3.94 | 1.67 | 193 |
| May 5 | J. H. Lewis | 45 | 56 | 4.61 | 1.78 | 270 |
| July 21 | W. C. Sawyer | 29 | 27 | 3.63 | 1.48 | 98 |
| August 12[a] | Sawyer and Lewis | 29 | 36 | 2.82 | 1.50 | 101 |
| September 14 | P. A. Cupper | 40 | 47 | 2.68 | 1.65 | 124 |
| October 16[a] | do | 35 | 46 | 2.96 | 1.65 | 136 |
| October 20[a] | do | 34 | 43 | 2.73 | 1.60 | 116 |
| November 21[a] | do | 31 | 42 | 2.73 | 1.48 | 114 |
| December 28[a] | do | 33 | 40 | 3.07 | 1.55 | 121 |

[a] Made at different section.

*Daily gage height, in feet, of South Fork of Walla Walla River near Milton, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.75 | 1.6 | 1.65 | 1.75 | 1.8 | 1.7 | 1.7 | 1.6 | 1.5 | 1.6 | 1.5 | 1.55 |
| 2 | 1.7 | 1.6 | 1.65 | 1.8 | 1.75 | 1.7 | 1.65 | 1.5 | 1.55 | 1.6 | 1.5 | 1.6 |
| 3 | 1.65 | 1.6 | 1.7 | 1.8 | 1.75 | 1.75 | 1.6 | 1.5 | 1.5 | ...... | ...... | 1.7 |
| 4 | 1.6 | 1.55 | 1.7 | 1.8 | ...... | 1.7 | 1.6 | 1.5 | 1.6 | 1.6 | ...... | 1.65 |
| 5 | 1.6 | 1.55 | 1.65 | 1.8 | 1.8 | 1.7 | 1.6 | 1.6 | 1.6 | 1.6 | 1.45 | 1.65 |
| 6 | 1.6 | 1.55 | 1.65 | 1.8 | 1.8 | 1.7 | 1.6 | 1.5 | 1.5 | ...... | 1.5 | 1.7 |
| 7 | 1.6 | 1.55 | 1.65 | 1.8 | 1.8 | 1.65 | 1.6 | 1.5 | 1.55 | 1.65 | 1.5 | 1.7 |
| 8 | 1.55 | ...... | 1.65 | ...... | 1.85 | 1.65 | 1.6 | 1.5 | 1.55 | 1.7 | 1.45 | 1.65 |
| 9 | 1.55 | ...... | 1.6 | 1.85 | 1.85 | 1.65 | 1.5 | 1.5 | 1.6 | 1.65 | 1.5 | 1.65 |
| 10 | ...... | ...... | 1.6 | 1.8 | 1.83 | ...... | 1.6 | 1.5 | 1.5 | 1.6 | 1.45 | 1.6 |
| 11 | 1.55 | 1.5 | 1.6 | 1.75 | 1.9 | 1.6 | 1.5 | 1.5 | 1.5 | 1.6 | 1.45 | 1.6 |
| 12 | 1.55 | 1.7 | 1.6 | 1.75 | 1.95 | 1.6 | 1.5 | 1.5 | 1.5 | 1.6 | 1.5 | 1.6 |
| 13 | 1.55 | 1.7 | 1.6 | 1.75 | 1.95 | 1.55 | 1.5 | 1.5 | 1.6 | 1.6 | 1.45 | 1.55 |
| 14 | 1.5 | 1.5 | 1.65 | 1.7 | 1.9 | 1.7 | 1.5 | 1.5 | 1.6 | 1.6 | 1.45 | ...... |
| 15 | 1.5 | 1.5 | ...... | 1.7 | 1.85 | 1.65 | 1.5 | 1.5 | 1.6 | 1.6 | 1.5 | 1.5 |
| 16 | 1.55 | 1.45 | 1.65 | 1.75 | 1.8 | 1.7 | 1.5 | 1.5 | 1.6 | 1.6 | 1.5 | 1.5 |
| 17 | 1.55 | 1.45 | 1.7 | 1.75 | 1.9 | 1 7 | 1.5 | 1.55 | 1.55 | 1.6 | 1.5 | 1.6 |
| 18 | 1.55 | 1.5 | 1.7 | 1.75 | 1.85 | 1.7 | 1.5 | 1.5 | 1.6 | 1.65 | 1.5 | 1.65 |
| 19 | 1.55 | 1.5 | 1.7 | 2.0 | 1.85 | 1.65 | 1.5 | 1.45 | 1.55 | 1.6 | 1.5 | 1.6 |
| 20 | 1.6 | 1.5 | 1.6 | 2.0 | 1.8 | 1.65 | 1.5 | 1.45 | 1.6 | 1.6 | 1.5 | 1.6 |
| 21 | 1.55 | 1.5 | 1.75 | 1.95 | 1.75 | 1.6 | 1.5 | 1.55 | 1.6 | 1.6 | 1.5 | 1.6 |
| 22 | 1.6 | ...... | 1.7 | 1.95 | 1.75 | 1.6 | 1.5 | 1.55 | 1.55 | ...... | 1.5 | 1.6 |
| 23 | 1.7 | 1.6 | 1.7 | 1.95 | 1.75 | 1.65 | 1.5 | 1.5 | 1.6 | 1.5 | 1.5 | 1.55 |
| 24 | 1.75 | 1.65 | 2.15 | 1.95 | ...... | 1.7 | 1.5 | 1.5 | 1.6 | 1.5 | 1.5 | 1.55 |
| 25 | 1.8 | 1.7 | 2.0 | 1.95 | ...... | 1.7 | 1.5 | 1.55 | 1.6 | 1.55 | 1.5 | ...... |
| 26 | 1.7 | 1.75 | 2.2 | 1.95 | 1.75 | 1.7 | 1.5 | 1.5 | 1.6 | 1.55 | 1.6 | ...... |
| 27 | 1.7 | ...... | 2.0 | 1.9 | 1.75 | 1.7 | 1.5 | 1.5 | 1.6 | 1.6 | 1.5 | ...... |
| 28 | 1.7 | ...... | 1.95 | 1.9 | 1.7 | 1.7 | 1.5 | 1.5 | 1.6 | ...... | 1.5 | 1.6 |
| 29 | 1.7 | ...... | 1.85 | 1.85 | 1.7 | 1.7 | 1.6 | 1.55 | 1.6 | 1.7 | 1.5 | 1.55 |
| 30 | 1.65 | ...... | 1.75 | 1.8 | 1.7 | 1.7 | 1.5 | 1.55 | 1.6 | 1.65 | ...... | 1.55 |
| 31 | 1.65 | ...... | 1.75 | ...... | 1.7 | ...... | 1.6 | 1.5 | ...... | 1.5 | ...... | 1.55 |

*Station rating table for South Fork of Walla Walla River near Milton, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.50 | 106 | 1.70 | 214 | 1.90 | 340 | 2.10 | 480 |
| 1.60 | 156 | 1.80 | 276 | 2.00 | 412 | 2.20 | 552 |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined. The table has been extended beyond these limits.

*Estimated monthly discharge of South Fork of Walla Walla River near Milton, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 276 | 106 | 167 | 10,270 |
| February | 244 | 84 | 142 | 7,886 |
| March | 552 | 156 | 239 | 14,700 |
| April | 412 | 214 | 300 | 17,850 |
| May | 378 | 214 | 277 | 17,030 |
| June | 244 | 130 | 196 | 11,660 |
| July | 214 | 106 | 127 | 7,809 |
| August | 156 | 84 | 112 | 6,887 |
| September | 156 | 106 | 141 | 8,390 |
| October | 214 | 106 | 157 | 9,654 |
| November | 156 | 84 | 103 | 6,129 |
| December | 214 | 106 | 155 | 9,531 |
| The year | 552 | 84 | 176 | 127,800 |

## WALLA WALLA RIVER ABOVE MILTON, OREG.

This station was established August 12, 1905, to replace the station at Milton, Oreg., one-half mile below. It is located near the old city reservoir, 1¼ miles above Milton. About 25 feet above the gage there is a curve in the low-water channel, but in high water it is nearly straight. Below, the channel is straight for about 400 feet. There are riffles a short distance above and below the cable. The channel is composed of coarse gravel and cobbles and may shift to some extent. Both banks are low, but seldom overflow beyond the limit of the cable.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the zero of the tagged wire on the right bank.

The gage is a vertical staff on the right bank, 24 feet above the cable. During 1905 the gage was read once each day by L. Martin. The bench mark is a spike under the corner of the roof of the old reservoir; elevation, 9.71 feet above the datum of the gage.

*Discharge measurements of Walla Walla River above Milton, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 12 | Lewis and Sawyer | 42 | 48 | 2.13 | 3.83 | 103 |
| September 6 | W. C. Sawyer | 43 | 47 | 2.22 | 3.85 | 104 |
| October 6 | P. A. Cupper | 43 | 54 | 2.47 | 3.95 | 133 |
| October 21 | .....do | 44 | 55 | 2.36 | 3.95 | 129 |
| November 21 | .....do | 43 | 53 | 2.52 | 3.98 | 132 |
| December 28 | .....do | 42 | 62 | 2.78 | 4.05 | 173 |

*Daily gage height, in feet, of Walla Walla River above Milton, Oreg., for 1905.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 3.88 | 3.92 | 4.0 | 4.02 | 17 | 3.88 | 3.9 | 3.98 | 3.95 | 4.15 |
| 2 | ...... | 3.82 | 3.92 | 4.0 | 4.1 | 18 | 3.85 | 3.9 | 3.98 | 3.98 | 4.18 |
| 3 | ...... | 3.82 | 3.9 | 3.98 | 4.22 | 19 | 3.88 | 3.9 | 3.98 | 4.0 | 4.2 |
| 4 | ...... | 3.85 | 3.9 | 4.0 | 4.25 | 20 | 3.85 | 3.9 | 3.98 | 4.0 | 4.15 |
| 5 | ...... | 3.85 | 3.92 | 3.98 | 4.22 | 21 | 3.88 | 3.9 | 3.9 | 3.98 | 4.15 |
| 6 | ...... | 3.85 | 3.98 | 3.98 | 4.2 | 22 | 3.88 | 3.88 | 3.95 | 3.98 | 4.12 |
| 7 | ...... | 3.85 | 4.0 | 3.98 | 4.2 | 23 | 3.85 | 3.88 | 3.98 | 3.95 | 4.10 |
| 8 | ...... | 3.85 | 4.0 | 3.95 | 4.2 | 24 | 3.85 | 3.88 | 4.0 | 3.95 | 4.08 |
| 9 | ...... | 3.85 | 3.98 | 3.95 | 4.18 | 25 | 3.88 | 3.88 | 4.05 | 3.95 | 4.08 |
| 10 | ...... | 3.82 | 3.95 | 4.0 | 4.12 | 26 | 3.88 | 3.9 | 4.1 | 4.12 | 4.08 |
| 11 | ...... | 3.85 | 3.95 | 3.98 | 4.12 | 27 | 3.88 | 3.95 | 4.0 | 4.12 | 4.08 |
| 12 | 3.82 | 3.88 | 3.92 | 3.96 | 4.08 | 28 | 3.85 | 3.98 | 4.0 | 4.08 | 4.05 |
| 13 | 3.85 | 3.9 | 3.9 | 3.95 | 4.05 | 29 | 3.88 | 3.92 | 3.98 | 4.02 | 4.05 |
| 14 | 3.88 | 3.9 | 3.9 | 3.95 | 4.02 | 30 | 3.88 | 3.92 | 4.0 | 4.05 | 4.05 |
| 15 | 3.88 | 3.9 | 3.98 | 3.95 | 4.02 | 31 | 3.9 | ...... | 4.0 | ...... | 4.05 |
| 16 | 3.9 | 3.9 | 3.95 | 3.92 | 4.02 | | | | | | |

*Station rating table for Walla Walla River above Milton, Oreg., from August 12 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 3.80 | 94 | 4.00 | 147 | 4.20 | 207 |
| 3.90 | 120 | 4.10 | 175 | 4.30 | 240 |

The above table is applicable only for open-channel conditions. It is based on six discharge measurements made during 1905. It is well defined to gage height 4 feet.

*Estimated monthly discharge of Walla Walla River above Milton, Oreg., for 1905.*

| Month | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| August 12-31 | 120 | 99 | 112 | 4,442 |
| September | 142 | 99 | 115 | 6,843 |
| October | 175 | 120 | 138 | 8,485 |
| November | 181 | 125 | 144 | 8,569 |
| December | 224 | 153 | 181 | 11,130 |

## WALLA WALLA RIVER AT MILTON, OREG.

This station was established February 14, 1903, by T. A. Noble. Owing to the influence of a diversion dam just below the station was abandoned September 30, 1905, the station 1¼ miles above Milton taking its place.

The channel is straight for 80 feet above and 150 feet below the station. The current is swift. Both banks are low, wooded, but not liable to overflow. There is but one channel at all stages. The bed of the stream is composed of gravel, is free from vegetation, and is liable to shift.

During 1903 discharge measurements were made from a cable. Measurements made at this point include the discharge of the irrigation ditch just below the gage. At the close of the season of 1903 the cable was abandoned and discharge measurements have since been made from the highway bridge. Measurements made at this point do not include the discharge of the irrigation ditch just below the gage. The ditch has to be measured separately, but its discharge is included in the estimate given below. Another irrigation ditch is taken out on the left bank just below the bridge; this is included in the measurements made at the bridge. The initial point for soundings is the end of the lower chord on the upstream side of the bridge, at the right bank. The bridge has a single span of 75 feet between abutments.

The gage is a vertical rod on the left bank one-half mile above the county bridge and just above the head gate of an irrigation ditch. During 1905 the gage was read once each day by S. L. Smith. The bench mark is the top of a sharp projecting rock, 4 feet from the gage and 3 feet from the tree to which the gage is attached; elevation, 4.37 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 100, p 368; 135, p 254.
**Discharge:** 100, p 369; 135, p 254.
**Discharge, monthly:** 100, p 370; 135, p 256.
**Gage heights:** 100, pp 369–370; 135, p 255.
**Rating table:** 100, p 370; 135, p 255.

*Discharge measurements of Walla Walla River at Milton, Oreg., in 1905.*

| Date. | Hydrographer. | Gage height. | Dis-charge. | Remarks. |
|---|---|---|---|---|
| | | *Feet.* | *Second-feet.* | |
| February 8 | W. C. Sawyer | 1.71 | 190 | 78 second-feet in ditch included. |
| March 18 | H. A. Yates | 1.85 | 240 | 64 second-feet in ditch included. |
| May 5 | J. H. Lewis | 1.75 | 378 | 77 second-feet in ditch included. |
| July 21 | W. C. Sawyer | 1.64 | 98 | 52 second-feet in ditch included. |
| August 11 | Sawyer and Lewis | 1.42 | 90 | Do. |
| September 1 | Sawyer and Cupper | 1.37 | 95 | 53 second-feet in ditch included. |

*Daily gage height, in feet, of Walla Walla River at Milton, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.74 | 1.54 | 1.81 | 1.7 | 1.65 | 1.55 | 1.94 | 1.48 | 1.4 |
| 2 | 1.69 | 1.51 | 1.8 | 1.78 | 1.62 | 1.55 | 1.88 | 1.46 | 1.39 |
| 3 | 1.56 | 1.52 | 1.8 | 1.76 | 1.7 | 2.11 | 1.88 | 1.45 | 1.4 |
| 4 | 1.56 | 1.74 | 1.8 | 1.75 | 1.72 | 2.06 | 1.86 | 1.44 | 1.41 |
| 5 | 1.56 | 1.74 | 1.79 | 1.74 | 1.72 | 2.03 | 1.84 | 1.43 | 1.41 |
| 6 | 1.53 | 1.72 | 1.78 | 1.73 | 1.72 | 2.0 | 1.82 | 1.4 | 1.41 |
| 7 | 1.48 | 1.72 | 1.76 | 1.75 | 1.67 | 1.97 | 1.78 | 1.36 | 1.41 |
| 8 | 1.45 | 1.71 | 1.75 | 1.78 | 1.66 | 1.95 | 1.68 | 1.36 | 1.4 |
| 9 | 1.48 | 1.71 | 1.74 | 1.78 | 1.86 | 1.92 | 1.58 | 1.36 | 1.4 |
| 10 | 1.5 | 1.71 | 1.78 | 1.8 | 1.92 | 1.9 | 1.5 | 1.36 | 1.41 |
| 11 | 1.51 | 1.68 | 1.81 | 1.74 | 2.02 | 1.82 | 1.5 | 1.37 | 1.42 |
| 12 | 1.52 | 1.66 | 1.82 | 1.67 | 1.99 | 1.78 | 1.73 | 1.37 | 1.43 |
| 13 | 1.51 | 1.64 | 1.84 | 1.68 | 1.93 | 1.74 | 1.7 | 1.36 | 1.45 |
| 14 | 1.49 | 1.62 | 1.84 | 1.69 | 1.85 | 1.72 | 1.7 | 1.37 | 1.46 |
| 15 | 1.5 | 1.61 | 1.84 | 1.66 | 1.8 | 1.7 | 1.66 | 1.38 | 1.46 |
| 16 | 1.51 | 1.61 | 1.83 | 1.66 | 1.75 | 1.7 | 1.65 | 1.4 | 1.45 |
| 17 | 1.5 | 1.7 | 1.84 | 1.64 | 1.73 | 1.72 | 1.63 | 1.46 | 1.45 |
| 18 | 1.51 | 1.74 | 1.84 | 1.66 | 1.71 | 1.64 | 1.62 | 1.44 | 1.45 |
| 19 | 1.49 | 1.8 | 1.84 | 1.66 | 1.68 | 1.57 | 1.6 | 1.43 | 1.45 |
| 20 | 1.53 | 1.79 | 1.84 | 1.7 | 1.64 | 1.64 | 1.62 | 1.42 | 1.46 |
| 21 | 1.51 | 1.76 | 1.95 | 1.8 | 1.62 | 1.64 | 1.64 | 1.43 | 1.46 |

*Daily gage height, in feet, of Walla Walla River at Milton, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 22 | 1.51 | 1.72 | 1.98 | 1.94 | 1.6 | 1.8 | 1.63 | 1.43 | 1.46 |
| 23 | 1.59 | 1.8 | 1.95 | 1.88 | 1.59 | 1.85 | 1.62 | 1.43 | 1.46 |
| 24 | 1.76 | 1.88 | 2.13 | 1.91 | 1.63 | 2.06 | 1.61 | 1.42 | 1.47 |
| 25 | 1.8 | 1.97 | 2.01 | 1.95 | 1.65 | 2.12 | 1.58 | 1.42 | 1.47 |
| 26 | 1.76 | 1.87 | 2.12 | 1.91 | 1.65 | 2.1 | 1.45 | 1.41 | 1.48 |
| 27 | 1.73 | 1.84 | 2.05 | 1.88 | 1.65 | 2.06 | 1.49 | 1.41 | 1.6 |
| 28 | 1.71 | 1.82 | 1.91 | 1.85 | 1.64 | 2.04 | 1.5 | 1.41 | 1.6 |
| 29 | 1.68 | ........ | 1.81 | 1.7 | 1.62 | 2.02 | 1.5 | 1.42 | 1.58 |
| 30 | 1.66 | ........ | 1.81 | 1.69 | 1.6 | 1.95 | 1.48 | 1.42 | 1.56 |
| 31 | 1.6 | ........ | 1.72 | ........ | 1.58 | ........ | 1.46 | 1.41 | ........ |

*Estimated monthly discharge of Walla Walla River at Milton, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 280 | 150 | 194 | 11,930 |
| February | 305 | 150 | 200 | 11,110 |
| March | 410 | 200 | 260 | 15,990 |
| April | 540 | 245 | 369 | 21,950 |
| May | 610 | 275 | 363 | 22,320 |
| June | 280 | 170 | 216 | 12,850 |
| July | 225 | 100 | 129 | 7,932 |
| August | 145 | 97 | 103 | 6,333 |
| September | 114 | 100 | 104 | 6,188 |
| The period | ........... | ........... | .......... | 116,600 |

NOTE.—Owing to changeable conditions at this station during 1905 no rating table can be published and the monthly estimates, which are based on a series of curves, each covering a short period, are only approximate.

## UMATILLA RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Umatilla River rises in the well-wooded country of northeastern Oregon and flows in a general westerly direction, entering Columbia River below the mouth of Walla Walla River. The country north of the Umatilla is high and rolling. A number of canals divert water from the lower course of the stream to irrigate lands on either side.

### UMATILLA RIVER AT GIBBON, OREG.

This station was established by C. C. Babb July 22, 1896.

The channel is straight for 100 feet above and below the station. The right bank is high. The left bank is rather low and has a slough during high water. The bed of the stream is composed of gravel and is somewhat shifting.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the face of the tree on the right bank, to which the cable is attached.

Several gages were used from time to time, owing to the varying conditions. October 15, 1904, a vertical staff gage was fastened to a point of rocks in a pool where the bed is least liable to shift on the north side of the river about one-half mile below the railroad station at Bingham Springs and one-half mile above the cable from which discharge measurements are made. No relation has been established between this and previous gages. During 1905 the gage was read once each day by Walter Swart. The bench mark is a square chisel draft and the letters "B. M." cut in the rock about 15 feet from the gage, 10 feet downstream; elevation, 5.17 feet above the datum of the gage.

**Information in regard to this station is contained in the following publications of the United States Geological Survey (Ann=Annual Report; WS=Water-Supply Paper):**

**Description:** Ann 18, iv, p 361; 19, iv, p 493; WS 16, p 180; 28, p 159; 38, pp 376–377; 51, p 444; 66, p 137; 85, pp 183–184; 100, pp 366–367; 135, pp 256–257.

**Discharge:** Ann 18, iv, p 361; WS 16, p 180; 28, p 169; 85, p 184; 100, p 367; 135, p 257.

**Discharge, monthly:** Ann 19, iv, p 494; 20, iv, p 515; 21, iv, p 430; 22, iv, p 453; WS 75, p 206; 85, p 185.

**Discharge, yearly:** Ann 20, iv, p 63.

**Gage heights:** WS 11, p 88; 16, p 180; 28, p 167; 38, p 377; 51, p 445; 66, p 137; 85, p 184; 100, pp 367–368; 135, pp 257–258.

**Hydrographs:** Ann 19, iv, p 494; 20, iv, p 515; 21, iv, p 430; 22, iv, p 453.

**Rating tables:** Ann 19, iv, p 493; WS 28, p 170; 39, p 454; 52, p 522; 66, p 177; 85, p 185.

### *Discharge measurements of Umatilla River at Gibbon, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 3 | J. H. Lewis | 100 | 85 | 6.36 | 2.00 | 540 |
| March 10 | W. C. Sawyer | 53 | 69 | 5.93 | 1.75 | 410 |
| March 28 | J. H. Lewis | 106 | 143 | 6.85 | 2.50 | 979 |
| April 7 | W. C. Sawyer | 110 | 167 | 6.57 | 2.65 | 1,094 |
| May 6 | do | 101 | 102 | 6.43 | 2.10 | 660 |
| August 5[a] | do | 34 | 41 | 1.41 | 1.10 | 58 |
| August 26 | do | 34 | 38 | 1.39 | 1.10 | 53 |
| October 19[a] | Sawyer and Hall | 37 | 49 | 1.73 | 1.22 | 85 |
| December 2[a] | R. S. Hall | 48 | 63 | 2.53 | 1.39 | 160 |

[a] Made at different section.

### *Daily gage height, in feet, of Umatilla River at Gibbon, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.5 | 1.6 | 2.0 | 2.3 | 1.8 | 1.55 | 1.3 | 1.1 | 1.1 | 1.25 | 1.2 | 1.35 |
| 2 | 1.5 | 1.5 | 2.0 | 2.4 | 1.9 | 1.7 | 1.3 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 3 | 1.5 | 1.5 | 2.0 | ....... | 2.0 | 1.65 | 1.3 | 1.1 | 1.1 | 1.15 | 1.2 | 1.52 |
| 4 | 1.4 | 1.5 | 1.9 | 2.5 | 2.0 | ....... | 1.3 | 1.1 | 1.1 | 1.15 | 1.2 | 1.65 |
| 5 | 1.4 | 1.5 | 1.9 | 2.8 | 2.0 | 1.6 | 1.3 | 1.1 | 1.1 | 1.2 | 1.2 | 1.62 |
| 6 | 1.4 | 1.5 | 1.9 | 2.8 | 2.1 | 1.6 | 1.3 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 7 | 1.4 | 1.5 | 1.8 | 2.65 | ....... | 1.6 | 1.25 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 8 | 1.4 | 1.5 | 1.8 | 2.5 | ....... | 1.55 | 1.25 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 9 | 1.4 | 1.5 | 1.75 | 2.5 | 2.1 | 1.5 | 1.25 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 10 | 1.4 | 1.5 | 1.75 | 2.3 | 2.1 | 1.5 | 1.25 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 11 | 1.4 | 1.5 | 1.7 | 2.1 | 2.25 | 1.45 | 1.2 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 12 | 1.4 | 1.5 | 1.7 | 2.2 | 2.2 | 1.4 | 1.2 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 13 | 1.3 | 1.5 | 1.8 | 2.1 | 2.1 | 1.4 | 1.15 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 14 | 1.3 | 1.5 | 1.8 | 2.0 | 2.0 | 1.35 | 1.15 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 15 | 1.3 | 1.5 | 1.8 | 2.0 | 1.95 | 1.35 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 16 | 1.3 | 1.5 | 1.8 | 2.0 | 1.9 | 1.35 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.4 |
| 17 | 1.3 | 1.4 | 1.8 | 1.95 | 1.85 | 1.3 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.5 |
| 18 | 1.3 | 1.4 | 1.8 | 1.9 | 1.8 | 1.3 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.55 |
| 19 | 1.3 | 1.4 | 1.8 | 2.0 | 1.8 | 1.3 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.55 |
| 20 | 1.3 | 1.4 | 1.8 | 2.1 | 1.8 | 1.25 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.55 |
| 21 | 1.3 | 1.4 | 2.0 | 2.2 | 1.7 | 1.25 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 22 | 1.3 | 1.4 | ....... | 2.3 | 1.5 | 1.25 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.6 |
| 23 | 1.6 | 1.5 | 2.0 | 2.3 | 1.7 | 1.25 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.55 |
| 24 | 2.0 | 1.6 | 2.4 | 2.2 | 1.85 | 1.3 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.5 |
| 25 | 2.2 | 2.0 | 2.2 | 2.1 | 1.9 | ....... | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | ...... |

*Daily gage height, in feet, of Umatilla River at Gibbon, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 2.0 | 2.0 | ....... | 2.0 | 1.8 | 1.35 | 1.1 | ....... | 1.1 | 1.2 | 1.3 | 1.45 |
| 27 | ....... | 2.0 | 2.6 | 1.9 | 1.8 | 1.4 | 1.1 | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 |
| 28 | 1.9 | 2.0 | 2.45 | 1.8 | 1.75 | 1.35 | 1.1 | 1.1 | 1.1 | 1.2 | 1.3 | 1.4 |
| 29 | 1.8 | ....... | 2.35 | 1.7 | 1.7 | 1.35 | 1.1 | 1.1 | 1.3 | 1.2 | 1.3 | 1.4 |
| 30 | 1.8 | ....... | 2.3 | 1.7 | 1.65 | 1.35 | 1.1 | 1.1 | 1.3 | 1.2 | 1.35 | 1.4 |
| 31 | 1.8 | ....... | 2.2 | ....... | 1.6 | ....... | 1.1 | 1.1 | ....... | 1.2 | ....... | 1.4 |

NOTE.—Ice conditions during part of February.

*Station rating table for Umatilla River at Gibbon, Oreg., from October 15, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 32 | 1.60 | 282 | 2.10 | 638 | 2.60 | 1,060 |
| 1.10 | 56 | 1.70 | 346 | 2.20 | 718 | 2.70 | 1,150 |
| 1.20 | 82 | 1.80 | 414 | 2.30 | 800 | 2.80 | 1,240 |
| 1.30 | 120 | 1.90 | 486 | 2.40 | 885 | 2.90 | 1,330 |
| 1.40 | 168 | 2.00 | 560 | 2.50 | 970 | 3.00 | 1,420 |
| 1.50 | 222 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1905. It is well defined.

*Estimated monthly discharge of Umatilla River at Gibbon, Oreg., for 1904 and 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| 1904. | | | | |
| October 15-31 | 90 | 56 | 78.4 | 2,644 |
| November | 120 | 56 | 78.9 | 4,695 |
| December | 346 | 82 | 117 | 7,194 |
| 1905. | | | | |
| January | 718 | 120 | 250 | 15,370 |
| February | 560 | 168 | 263 | 14,610 |
| March | 1,060 | 346 | 554 | 34,060 |
| April | 1,240 | 346 | 721 | 42,900 |
| May | 759 | 222 | 489 | 30,070 |
| June | 346 | 101 | 182 | 10,830 |
| July | 120 | 56 | 76.7 | 4,716 |
| August | 56 | 56 | 56.0 | 3,443 |
| September | 120 | 56 | 60.3 | 3,588 |
| October | 101 | 69 | 81.8 | 5,030 |
| November | 144 | 82 | 89.1 | 5,302 |
| December | 314 | 144 | 220 | 13,530 |
| The year | 1,240 | 56 | 254 | 183,400 |

NOTE.—Discharge interpolated for missing gage heights.

## UMATILLA RIVER AT PENDLETON, OREG.

This station was established May 22, 1903, by F. W. Huber and discontinued June 11. 1905. It is located at the Main Street Bridge at Pendleton, Oreg.

The channel is straight for 250 feet above and 200 feet below the railroad bridge from which discharge measurements are made. The current is swift at this point, but has a lower velocity than at the bridge at which the gage is located. The right bank is low and will overflow under the trestle on this bank. The left bank is high and is partly riprap. At low stages there will be some backwater at the south bank. There is but one channel at all stages. The bed of the stream is composed of gravel and is shifting.

Discharge measurements are made from the Oregon Railroad and Navigation Company's bridge, about 1 mile downstream from the Main Street Bridge. The initial point for soundings is the face of the crib abutment on the left bank. The railroad bridge consists of a single span of 145 feet, with 116 feet of trestle approach on the right bank and 34 feet on the left bank.

The gage is a vertical staff fastened to the middle of the left (south) side of the center pier of the Main Street Bridge. During 1905 the gage was read by the staff of the Geological Survey office at Pendleton. The bench mark is the top of the south side of the steel caisson at the east end of the middle pier of the Main Street Bridge; elevation, 16.50 feet above the datum of the gage.

The flour-mill ditch (Byer's) takes 100 second-feet or less of water about 1½ miles above the gage and returns it to the river about 200 feet above the gage, so that it interferes with the measurements in no way except for a time during very low water, when the water is drawn down and then restored. The gage was read only when the flow was normal.

A short distance above the bridge at which the gage is located water is taken out of the river by the Farmers' mill ditch. The water is returned to the river at a point about 1,500 feet above the railroad bridge. The Farmers' mill ditch does not affect the reading of the gage when above 4 feet. For low stages of the river the amount of water in the ditch should be taken out from the measured discharge in making a curve and rating table, and should then be added to the discharge taken from the table. June 15, 1904, a gage was placed on the Farmers' mill ditch and read from that time until the station was abandoned.

Information in regard to this station is contained in the following publications of the United States Geological Survey (Bull=Bulletin; WS=Water-Supply Paper):

Description: Bull 131, p 68; WS 100, pp 362-363; 135, pp 258-259.
Discharge: Bull 131, pp 69, 90; WS 100, p 364; 135, p 259.
Discharge, monthly: Bull 131, p 69.
Gage heights: WS 100, p 364; 135, p 260.

*Discharge measurements of Umatilla River at Pendleton, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. | Remarks. |
|---|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* | |
| January 28 | Williams and Yates | 90 | 294 | 2.24 | 4.60 | 657 | 128 second-feet in ditch included. |
| February 24 | Lewis and Yates | 83 | 211 | 1.30 | 4.19 | 275 | 58 second-feet in ditch included. |
| February 27 | W. C. Sawyer | 92 | 269 | 2.29 | 4.58 | 615 | 120 second-feet in ditch included. |
| March 24 | H. S. Williams | 100 | 318 | 2.98 | 4.99 | 941 | 240 second-feet in ditch included. |
| March 28 | Lewis and Yates | 100 | 352 | 3.69 | 5.20 | 1,302 | 166 second-feet in ditch included. |
| June 8 | W. C. Sawyer | 80 | 207 | 1.35 | 4.26 | 280 | 29 second-feet in ditch included. |
| June 26 | Sawyer and King | 80 | 194 | .84 | 4.17 | 162 | Ditch dry. |
| August 28[a] | Sawyer and Landes | 16 | 16.6 | 2.22 | ........ | 36.9 | |
| September 9[a] | W. C. Sawyer | 27 | 22.8 | 1.79 | ........ | 40.4 | |
| October 19[a] | do | 45 | 52 | 1.37 | ........ | 72 | |
| November 15[a] | R. S. Hall | 45 | 52 | 1.43 | ........ | 79 | |
| November 17 | do | 76 | 90 | .29 | ........ | 56 | |
| November 17 | do | 76 | 90 | .33 | ........ | 63 | |
| December 7 | do | 73 | 248 | 1.07 | ........ | 264 | |
| December 7 | do | 73 | 248 | 1.10 | ........ | 273 | |
| December 26 | do | 73 | 242 | .98 | ........ | 237 | |

[a] Measurements made above head of Byer's mill ditch.

*Daily gage height, in feet, of Umatilla River at Pendleton, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | Day. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.05 | 4.35 | 4.52 | 4.99 | 4.5 | 4.45 | 17 | 3.87 | 4.03 | 4.38 | 4.65 | ...... | ...... |
| 2 | 4.0 | 4.28 | 4.5 | 5.21 | 4.45 | 4.4 | 18 | 3.88 | 4.02 | 4.38 | 4.65 | 4.55 | ...... |
| 3 | 4.0 | 4.23 | 4.52 | 5.25 | 4.5 | 4.37 | 19 | 3.88 | 4.0 | 4.38 | 4.63 | 4.5 | ...... |
| 4 | 3.98 | 4.19 | 4.52 | 5.15 | 4.6 | 4.35 | 20 | 3.88 | 4.02 | 4.39 | 4.77 | 4.45 | ...... |
| 5 | 3.97 | 4.14 | 4.52 | 5.22 | 4.7 | 4.33 | 21 | 3.9 | 4.02 | 4.48 | 4.80 | 4.45 | ...... |
| 6 | 3.95 | 4.11 | 4.5 | 5.3 | 4.73 | 4.3 | 22 | ...... | 4.07 | 4.58 | 4.80 | 4.4 | ...... |
| 7 | 3.92 | 4.1 | 4.49 | 5.25 | 4.72 | 4.28 | 23 | 4.0 | 4.1 | 4.62 | 4.85 | 4.42 | ...... |
| 8 | 3.9 | 4.09 | 4.42 | 5.15 | 4.67 | 4.26 | 24 | 4.48 | 4.19 | 5.0 | 4.82 | 4.5 | ...... |
| 9 | 3.9 | 4.08 | 4.38 | 5.05 | 4.8 | 4.24 | 25 | 4.78 | 4.39 | 4.98 | 4.78 | 4.55 | ...... |
| 10 | 3.9 | 4.08 | 4.35 | 4.95 | 4.78 | 4.2 | 26 | 4.61 | 4.56 | 5.33 | 4.75 | 4.52 | ...... |
| 11 | 3.9 | 4.1 | 4.38 | 4.85 | 4.82 | 4.18 | 27 | 4.6 | 4.58 | 5.45 | 4.66 | 4.55 | ...... |
| 12 | 3.9 | 4.0 | 4.37 | 4.83 | 4.85 | ...... | 28 | 4.61 | 4.5 | 5.3 | 4.6 | 4.5 | ...... |
| 13 | 3.8 | 4.1 | 4.32 | 4.78 | 4.8 | ...... | 29 | 4.59 | ...... | 5.12 | 4.55 | 4.5 | ...... |
| 14 | 3.8 | 4.05 | 4.4 | 4.75 | 4.75 | ...... | 30 | 4.5 | ...... | 5.05 | 4.52 | 4.45 | ...... |
| 15 | 3.86 | 4.0 | 4.4 | 4.65 | 4.68 | ...... | 31 | 4.41 | ...... | ...... | ...... | 4.45 | ...... |
| 16 | 3.84 | 4.0 | 4.38 | 4.65 | 4.65 | ...... | | | | | | | |

## UMATILLA RIVER AT YOAKUM, OREG.

This station was established May 5, 1903, by N. S. Dils. It is located one-half mile east of Yoakum, a station of the Oregon Railroad and Navigation Company, at what is known as the Yoakum wagon bridge.

The channel is straight for 1,000 feet above and below the station. The current is swift and has a well-distributed velocity. Both banks are high and are composed of gravel. The right bank will not overflow. The left bank will overflow only at extreme flood stages.

The bed of the stream is composed of gravel and is permanent. There is but one channel at all stages.

Discharge measurements are made from the single-span wagon bridge. The initial point for soundings is the end of the lower chord of the upstream side on the left bank.

The gage is a vertical staff attached to the right abutment of the bridge. During 1905 readings have been made once each day by Luther Dehaven. The bench mark is a 60-penny nail and two 8-penny nails driven side by side into the second timber from the top of the left abutment, downstream side; elevation, 13.00 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, pp 360-361; 135, pp 260-261.
Discharge: 100, p 361; 135, p 261.
Discharge, monthly: 100, p 362; 135, p 263.
Gage heights: 100, p 361; 135, pp 261-262.
Rating table: 100, p 362; 135, p 262.

*Discharge measurements of Umatilla River at Yoakum, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 25 | J. H. Lewis | 76 | 209 | 2.12 | 4.28 | 444 |
| March 24 | Lewis and Yates | 76 | 296 | 3.99 | 5.48 | 1,180 |
| May 8 | W. C. Sawyer | 76 | 273 | 3.14 | 4.93 | 856 |
| June 30 | do | 76 | 129 | 1.36 | 3.37 | 175 |
| August 18[a] | do | 49 | 30 | .80 | 2.66 | 24 |
| September 1 | F. C. Dillard | 73 | 96 | .55 | 2.98 | 54 |
| October 1[a] | W. C. Sawyer | 60 | 47 | 1.28 | 3.00 | 60 |
| October 21 | Sawyer and Hall | 74 | 120 | .61 | 3.12 | 74 |
| December 12 | R. S. Hall | 76 | 188 | 1.52 | 3.98 | 287 |

[a] Measurements made at different section.

*Daily gage height, in feet, of Umatilla River at Yoakum, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.0 | 4.3 | 4.5 | 5.5 | 4.4 | 4.1 | 3.3 | 2.6 | 2.7 | 3.0 | 3.3 | 3.4 |
| 2 | 4.0 | 4.2 | 4.6 | 6.1 | 4.3 | 4.1 | 3.1 | 2.6 | 2.7 | 3.0 | 3.3 | 3.5 |
| 3 | 3.9 | 4.1 | 4.6 | 6.0 | 4.4 | 4.1 | 3.1 | 2.6 | 2.7 | 3.0 | 3.3 | 3.6 |
| 4 | 3.9 | 4.0 | 4.6 | 6.0 | 4.7 | 4.1 | 3.1 | 2.6 | 2.7 | 3.0 | 3.3 | 4.1 |
| 5 | 3.9 | 4.0 | 4.6 | 6.0 | 5.0 | 4.1 | 3.1 | 2.6 | 2.7 | 3.0 | 3.3 | 4.1 |
| 6 | 3.9 | 3.9 | 4.6 | 6.0 | 5.0 | 4.1 | 3.0 | 2.6 | 2.7 | 3.1 | 3.3 | 4.1 |
| 7 | 3.9 | 3.9 | 4.6 | 6.0 | 5.0 | 4.1 | 3.0 | 2.6 | 2.7 | 3.2 | 3.3 | 4.1 |
| 8 | 3.8 | 3.8 | 4.5 | 6.0 | 4.9 | 3.9 | 3.0 | 2.6 | 2.7 | 3.2 | 3.3 | 4.3 |
| 9 | 3.7 | 3.8 | 4.4 | 5.7 | 5.2 | 3.9 | 3.0 | 2.6 | 2.75 | 3.2 | 3.3 | 4.3 |
| 10 | 3.7 | 3.7 | 4.4 | 5.6 | 5.2 | 3.9 | 3.0 | 2.6 | 2.75 | 3.1 | 3.2 | 4.3 |
| 11 | 3.7 | 3.6 | 4.4 | 5.4 | 5.2 | 3.8 | 3.0 | 2.6 | 2.75 | 3.1 | 3.2 | 4.2 |
| 12 | 3.7 | 3.5 | 4.4 | 5.2 | 5.3 | 3.7 | 3.0 | 2.6 | 3.12 | 3.1 | 3.2 | 4.0 |
| 13 | 3.6 | 3.5 | 4.4 | 5.1 | 5.2 | 3.7 | 3.0 | 2.6 | 3.5 | 3.1 | 3.2 | 4.0 |
| 14 | 3.5 | 3.5 | 4.4 | 5.0 | 5.0 | 3.6 | 3.0 | 2.6 | 2.8 | 3.1 | 3.2 | 3.9 |
| 15 | 3.5 | 3.5 | 4.4 | 4.9 | 4.9 | 3.5 | 3.0 | 2.6 | 2.9 | 3.3 | 3.2 | 3.9 |
| 16 | 3.5 | 3.5 | 4.4 | 4.9 | 4.7 | 3.4 | 3.0 | 2.6 | 2.9 | 3.3 | 3.2 | 3.8 |
| 17 | 3.5 | 3.5 | 4.4 | 4.8 | 4.7 | 3.4 | 3.0 | 2.7 | 2.9 | 3.3 | 3.2 | 3.6 |
| 18 | 3.5 | 3.5 | 4.4 | 4.9 | 4.6 | 3.4 | 2.9 | 2.7 | 2.9 | 3.2 | 3.2 | 4.0 |
| 19 | 3.5 | 3.9 | 4.4 | 5.0 | 4.5 | 3.3 | 2.9 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |
| 20 | 3.6 | 3.7 | 4.4 | 5.0 | 4.4 | 3.2 | 2.9 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |

*Daily gage height, in feet, of Umatilla River at Yoakum, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 3.6 | 3.6 | 4.5 | 5.0 | 4.4 | 3.2 | 2.9 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |
| 22 | 3.7 | 3.5 | 4.7 | 5.0 | 4.3 | 3.2 | 2.9 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |
| 23 | 3.8 | 3.6 | 4.8 | 5.0 | 4.3 | 4.0 | 2.8 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |
| 24 | 4.3 | 4.0 | 5.4 | 5.0 | 4.4 | 3.6 | 2.8 | 2.7 | 2.9 | 3.1 | 3.3 | 4.1 |
| 25 | 4.8 | 4.3 | 5.5 | 5.0 | 4.4 | 3.5 | 2.7 | 2.7 | 2.9 | 3.1 | 3.3 | 4.5 |
| 26 | 4.8 | 4.4 | 5.9 | 4.9 | 4.4 | 3.4 | 2.7 | 2.7 | 3.1 | 3.1 | 3.3 | 4.5 |
| 27 | 4.7 | 4.4 | 6.2 | 4.6 | 4.3 | 3.4 | 2.7 | 2.7 | 3.2 | 3.1 | 3.3 | 4.4 |
| 28 | 4.7 | 4.4 | 6.0 | 4.6 | 4.3 | 3.4 | 2.6 | 2.7 | 3.0 | 3.2 | 3.3 | 4.5 |
| 29 | 4.5 | ....... | 5.8 | 4.5 | 4.2 | 3.4 | 2.6 | 2.7 | 3.0 | 3.2 | 3.4 | 4.5 |
| 30 | 4.4 | ....... | 5.5 | 4.4 | 4.2 | 3.2 | 2.6 | 2.7 | 3.0 | 3.2 | 3.4 | 4.3 |
| 31 | 4.3 | ....... | 5.5 | ....... | 4.1 | ....... | 2.6 | 2.7 | ....... | 3.2 | ....... | 4.3 |

*Station rating table for Umatilla River at Yoakum, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.60 | 20 | 3.60 | 182 | 4.50 | 565 | 5.40 | 1,270 |
| 2.70 | 28 | 3.70 | 210 | 4.60 | 630 | 5.50 | 1,360 |
| 2.80 | 37 | 3.80 | 240 | 4.70 | 700 | 5.60 | 1,455 |
| 2.90 | 47 | 3.90 | 275 | 4.80 | 770 | 5.70 | 1,550 |
| 3.00 | 59 | 4.00 | 315 | 4.90 | 845 | 5.80 | 1,645 |
| 3.10 | 73 | 4.10 | 355 | 5.00 | 925 | 5.90 | 1,740 |
| 3.20 | 90 | 4.20 | 400 | 5.10 | 1,005 | 6.00 | 1,840 |
| 3.30 | 110 | 4.30 | 450 | 5.20 | 1,090 | 6.10 | 1,940 |
| 3.40 | 132 | 4.40 | 505 | 5.30 | 1,180 | 6.20 | 2,040 |
| 3.50 | 156 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1904-5. It is well defined.

*Estimated monthly discharge of Umatilla River at Yoakum, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 770 | 156 | 320 | 19,680 |
| February | 505 | 156 | 273 | 15,160 |
| March | 2,040 | 505 | 826 | 50,790 |
| April | 1,940 | 505 | 1,153 | 68,610 |
| May | 1,180 | 355 | 683 | 42,000 |
| June | 355 | 90 | 212 | 12,620 |
| July | 110 | 20 | 51.1 | 3,142 |
| August | 28 | 20 | 23.9 | 1,470 |
| September | 156 | 28 | 48.2 | 2,868 |
| October | 110 | 59 | 78.7 | 4,839 |
| November | 132 | 90 | 105 | 6,248 |
| December | 565 | 132 | 368 | 22,630 |
| The year | 2,040 | 20 | 345. | 250,100 |

## UMATILLA RIVER NEAR UMATILLA, OREG.

This station was established October 21, 1903, by John H. Lewis. It is located about 2 miles above Umatilla, Oreg., and about one-fourth mile below the diversion dam of the Oregon Land and Water Company. This dam diverts water into an irrigation ditch on the left bank. To obtain the total discharge of the river, the discharge of the irrigation ditch must be added to that of the river at the cable. For estimate of flow in the ditch see page 201.

The channel is straight for 500 feet above and 1,000 feet below the cable. The current is swift. Both banks are high and rocky and will not overflow. The bed of the stream is composed of solid rock and is free from vegetation and permanent. Owing to the rapids just above Umatilla backwater from Columbia River does not affect the gage heights at the station.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the zero mark on the tagged wire, directly over the vertical portion of the left bank.

An inclined gage is placed on the left bank 45 feet below the cable, and is in two sections. The lower section reads from 1.2 to 3.5 feet. The upper section reads from 3.5 to 10.8 feet. During 1905 the gage was read every other day during ordinary stages and once each day during floods by B. V. Pompella. The bench mark is the head of a bolt cemented in the solid rock 1½ feet upstream from the gage rod; elevation, 10.30 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 100, p 359; 135, pp 263-264.
Discharge: 100, p 360; 135, p 264.
Discharge, monthly: 135, p 266.
Gage heights: 100, p 360; 135, pp 264-265.
Rating table: 135, p 265.

*Discharge measurements of Umatilla River near Umatilla, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 28 | J. H. Lewis | 170 | 218 | 2.78 | 3.37 | 606 |
| March 27 | do | 177 | 379 | 4.54 | 4.22 | 1,722 |
| April 10 | do | 186 | 330 | 4.17 | 3.95 | 1,377 |
| May 12 | W. C. Sawyer | 175 | 280 | 3.94 | 3.70 | 1,103 |
| July 19 | do | | | | 1.60 | [a]0.1 |
| September 26 | do | 7.3 | 4.7 | .85 | 1.82 | 4.0 |
| October 25 | Sawyer and Hall | 31 | 38 | 1.63 | 2.41 | 62 |
| December 6 | R. S. Hall | 167 | 148 | 2.06 | 3.00 | 304 |

[a] Estimated.

*Daily gage height, in feet, of Umatilla River near Umatilla, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.8 | | | 3.85 | | 3.05 | 2.3 | | 1.6 | 1.9 | | |
| 2 | | 3.15 | 3.35 | | 3.15 | | | 1.6 | | | 2.43 | 2.68 |
| 3 | 2.85 | | | 4.2 | | 2.95 | 2.1 | | 1.6 | 2.2 | | |
| 4 | | 3.05 | 3.4 | | 3.25 | | | 1.61 | | | 2.43 | 2.7 |
| 5 | 2.85 | | | 4.1 | | 2.9 | 1.8 | | 1.6 | 2.18 | | |
| 6 | | 3.0 | 3.4 | 4.2 | 3.6 | | | 1.61 | | | 2.43 | 3.0 |
| 7 | 2.8 | | | | | 2.9 | 1.7 | | 1.6 | 2.21 | | |
| 8 | | 2.9 | 3.3 | 4.15 | 3.6 | | | 1.61 | | | 2.41 | 3.0 |
| 9 | 2.8 | | | | | 2.8 | 1.65 | | 1.6 | 2.25 | | |
| 10 | | 2.9 | 3.2 | 3.95 | 3.7 | | | 1.6 | | | 2.4 | 3.0 |
| 11 | 2.8 | | | | | 2.7 | 1.6 | | 1.62 | 2.3 | | |
| 12 | | 2.9 | 3.2 | 3.7 | 3.8 | | | 1.6 | | | 2.4 | 2.95 |
| 13 | 2.95 | | | | | 2.6 | 1.55 | | 2.27 | 2.3 | | |
| 14 | | 2.75 | 3.2 | 3.65 | 3.7 | | | 1.7 | | | 2.4 | 2.9 |
| 15 | 2.95 | | | | | 2.45 | 1.5 | | 2.35 | 2.36 | | |
| 16 | | 2.8 | 3.15 | 3.5 | 3.45 | | | 1.6 | | | 2.45 | 2.85 |
| 17 | 2.9 | | | | | 2.3 | 1.5 | | 2.1 | 2.4 | | |
| 18 | | 2.8 | 3.2 | 3.45 | 3.4 | | | 1.6 | | | 2.42 | 2.9 |
| 19 | 2.7 | | | | | 2.2 | 1.6 | | 2.0 | 2.41 | | |
| 20 | | 2.8 | 3.15 | 3.4 | 3.2 | | | 1.6 | | | 2.45 | 3.1 |
| 21 | 2.7 | | | | | 2.2 | 1.6 | | 1.89 | 2.43 | | |
| 22 | | 2.8 | 3.25 | 3.55 | 3.1 | | | 1.6 | | | 2.5 | 3.0 |
| 23 | 2.75 | | | | | 1.9 | 1.6 | | 1.89 | 2.42 | | |
| 24 | | 2.85 | 3.5 | 3.6 | 3.1 | | | 1.6 | | | 2.5 | 2.95 |
| 25 | 3.15 | | | | | 2.2 | 1.59 | | 1.89 | 2.45 | | |
| 26 | | 3.15 | 3.8 | 3.5 | 3.2 | 2.4 | | 1.6 | | | 2.5 | 2.95 |
| 27 | 3.45 | | 4.22 | | | 2.35 | 1.6 | | 1.8 | 2.5 | | |
| 28 | | 3.37 | 4.3 | 3.4 | 3.15 | | | 1.6 | | | 2.55 | 2.9 |
| 29 | 3.4 | | 4.3 | | | 2.3 | 1.65 | | 1.89 | 2.5 | | |
| 30 | | | 4.0 | 3.2 | 3.1 | | | 1.6 | | | 2.65 | 2.9 |
| 31 | 3.3 | | | | | | 1.6 | | | 2.43 | | |

*Station rating table for Umatilla River near Umatilla, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.00 | 13 | 2.60 | 110 | 3.20 | 480 | 3.80 | 1,170 |
| 2.10 | 21 | 2.70 | 145 | 3.30 | 580 | 3.90 | 1,310 |
| 2.20 | 32 | 2.80 | 190 | 3.40 | 690 | 4.00 | 1,450 |
| 2.30 | 45 | 2.90 | 245 | 3.50 | 800 | 4.10 | 1,590 |
| 2.40 | 62 | 3.00 | 310 | 3.60 | 920 | 4.20 | 1,740 |
| 2.50 | 83 | 3.10 | 390 | 3.70 | 1,040 | 4.30 | 1,890 |

The above table is applicable only for open-channel conditions. It is based on 16 discharge measurements made during 1903–1905. It is well defined.

*Estimated monthly discharge of Umatilla River near Umatilla, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 745 | 145 | 307 | 18,880 |
| February | 557 | 168 | 283 | 15,720 |
| March | 1,890 | 435 | 764 | 46,980 |
| April | 1,740 | 480 | 1,085 | 64,560 |
| May | 1,170 | 390 | 670 | 41,200 |
| June | 350 | 8 | 122 | 7,260 |
| July | 45 | .0 | 4.62 | 218 |
| August | 1.5 | .1 | .21 | 35 |
| September | 54 | .1 | 11 | 654 |
| October | 83 | 8 | 53.2 | 3,271 |
| November | 128 | 62 | 75.8 | 4,510 |
| December | 390 | 138 | 263 | 16,170 |
| The year | 1,890 | .0 | 303 | 219,500 |

NOTE.—Mean for actual number of days recorded taken as the mean for the entire month.

## DITCHES IN UMATILLA RIVER VALLEY, OREGON.

### FARMERS' MILL DITCH AT PENDLETON, OREG.

Water is taken from Umatilla River just above the Main Street Bridge (upon a pier of which the river gage is located), is used to furnish power for the Farmers' flour mill, and then returned to the river above the railroad bridge at which river measurements were made.

The flow is not uniform during the low-water season because of storage in Byer's mill ditch above, and consequently measurements were discontinued.

*Discharge measurements of Farmers' mill ditch at Pendleton, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet* | *Second-feet.* |
| February 24 | Lewis and Yates | 24 | 28.3 | 2.13 | 0.82 | 60 |
| February 27 | Sawyer and Yates | 28 | 43.3 | 2.80 | 1.35 | 121 |
| April 6 | do | 23 | 41.8 | 4.98 | 1.66 | 201 |

*Daily gage height, in feet, of Farmers' mill ditch at Pendleton, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | Day. | Jan. | Feb. | Mar. | Apr. | May. | June. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 0.93 | 1.29 | 1.31 | 0.7 | 0.5 | 17 | 1.02 | 0.52 | 1.08 | 0.9 | | |
| 2 | 1.09 | .92 | 1.28 | 1.55 | .6 | .45 | 18 | 1.03 | .46 | 1.08 | .85 | 0.7 | |
| 3 | 1.09 | .85 | 1.29 | 1.58 | .7 | .51 | 19 | 1.03 | .45 | 1.08 | .82 | .65 | |
| 4 | 1.08 | .81 | 1.29 | 1.5 | .8 | .5 | 20 | 1.03 | .45 | 1.09 | 1.05 | .6 | |
| 5 | 1.08 | .76 | 1.29 | 1.55 | .97 | .48 | 21 | 1.09 | .5 | 1.23 | 1.12 | .57 | |
| 6 | 1.07 | .71 | 1.28 | 1.65 | 1.0 | .45 | 22 | | .57 | 1.33 | 1.1 | .55 | |
| 7 | 1.06 | .68 | 1.22 | 1.61 | 1.0 | .4 | 23 | 1.28 | .67 | 1.48 | 1.12 | .55 | |
| 8 | 1.06 | .65 | 1.18 | 1.48 | .95 | .38 | 24 | 1.33 | .78 | 1.76 | 1.12 | .65 | |
| 9 | 1.05 | .6 | 1.08 | 1.35 | 1.1 | .34 | 25 | 1.6 | 1.18 | 1.7 | 1.08 | .75 | |
| 10 | 1.05 | .6 | 1.05 | 1.28 | 1.06 | .3 | 26 | 1.51 | 1.34 | 1.86 | 1.02 | .78 | |
| 11 | 1.05 | .7 | 1.05 | 1.15 | 1.12 | .28 | 27 | 1.38 | 1.34 | 1.88 | .92 | .78 | |
| 12 | 1.05 | .55 | 1.03 | 1.12 | 1.18 | .28 | 28 | 1.39 | 1.3 | 1.7 | .83 | .7 | |
| 13 | 1.05 | 1.01 | .98 | 1.08 | 1.12 | | 29 | 1.35 | | 1.49 | .73 | .69 | |
| 14 | 1.05 | 1.0 | 1.11 | 1.02 | 1.05 | | 30 | 1.27 | | 1.38 | .7 | .6 | |
| 15 | 1.02 | .78 | 1.11 | .92 | .95 | | 31 | 1.13 | | | | .55 | |
| 16 | 1.02 | .6 | 1.08 | .9 | .85 | | | | | | | | |

### HORSESHOE IRRIGATION COMPANY'S DITCH AT YOAKUM, OREG.

This ditch was dug during the latter part of 1904, and plans are being considered to enlarge and extend it. It diverts water from the left bank of Umatilla River, 1 mile above Yoakum, at Dehaven's ranch. No measurements were made during 1905. No water was used after the last of July.

### SLUSHER & GOULD DITCH NEAR NOLIN, OREG.

This ditch diverts water from the left bank of Umatilla River, 1½ miles above Nolin, Oreg., and 8 miles above Echo.

Measurements were made in a flume near the head of the ditch.

*Discharge measurements of Slusher & Gould ditch near Nolin, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | W. C. Sawyer | 2.29 | 0.76 | 0.71 | 1.74 |
| September 9 | F. C. Dillard | 1.23 | .46 | .44 | .56 |
| September 19 | do | .58 | .53 | .30 | .31 |
| September 25 | do | 1.14 | .57 | .44 | .65 |
| September 29 | do | 1.51 | .64 | .55 | .96 |
| October 4 | do | 1.32 | .59 | .50 | .78 |
| October 10 | do | 1.55 | .44 | .48 | .68 |
| October 17 | do | 1.13 | .48 | .46 | .54 |
| October 23 | do | 1.21 | .45 | .49 | .55 |
| October 30 | do | 1.18 | .47 | .48 | .56 |
| November 7 | do | 1.04 | .46 | .44 | .48 |
| November 13 | do | .59 | .36 | .30 | .21 |
| November 20 | do | 1.03 | 38 | .40 | .39 |
| December 21 | do | 3.16 | .75 | .80 | 2.38 |

### LISLE & CRANE DITCH NEAR ECHO, OREG.

This ditch diverts water from the right bank of Umatilla River, 2 miles below Nolin.

Measurements were made in a flume just below where the ditch is crossed by the Oregon Railroad and Navigation Company's track.

*Discharge measurements of Lisle & Crane ditch near Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | W. C. Sawyer | 8.62 | 0.52 | .......... | 4.50 |
| August 30 | Sawyer and Dillard | 4.29 | .65 | 1.26 | 2.79 |
| September 9 | F. C. Dillard | 5.72 | 1.20 | 1.61 | 6.86 |
| September 14 | do | 5.06 | .97 | 1.43 | 4.92 |
| September 19 | do | 5.64 | 1.16 | 1.55 | 6.54 |
| September 25 | do | 5.27 | 1.02 | 1.48 | 5.40 |
| September 29 | do | 6.27 | 1.27 | 1.68 | 7.99 |
| October 9 | do | 5.86 | 1.17 | 1.61 | 6.84 |
| October 12 | do | 4.37 | .59 | 1.27 | 2.58 |

### CHARLES LISLE DITCH AT ECHO, OREG.

This ditch diverts water from the left bank of Umatilla River, 2½ miles above Echo.

*Discharge measurements of Charles Lisle ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | W. C. Sawyer | 4.78 | 2.98 | 0.62 | 1.42 |
| August 30 | F. C. Dillard | 4.86 | .18 | .64 | .88 |
| September 8 | do | 11.37 | .42 | 1.31 | 4.74 |
| September 19 | do | 9.70 | .51 | 1.16 | 4.96 |
| September 25 | do | 6.24 | .49 | .81 | 3.04 |
| October 4 | do | 5.17 | .47 | .71 | 2.44 |
| October 7 | do | 5.65 | .43 | .76 | 2.41 |
| October 9 | do | 5.58 | .44 | .77 | 2.44 |
| October 12 | do | 5.64 | .4 | .78 | 2.26 |
| October 17 | do | 5.70 | .45 | .79 | 2.53 |
| October 21 | do | 5.93 | .32 | .80 | 1.88 |
| October 23 | do | 5.69 | .38 | .80 | 2.18 |
| October 26 | do | 5.91 | .32 | .82 | 1.92 |
| October 30 | do | 6.25 | .32 | .87 | 1.98 |
| November 2 | do | 6.24 | .29 | .88 | 1.82 |
| November 7 | do | 6.40 | .25 | .87 | 1.59 |
| November 10 | do | 6.51 | .24 | .90 | 1.56 |
| November 13 | do | 6.84 | .24 | .91 | 1.66 |
| November 16 | do | 7.01 | .24 | .96 | 1.66 |
| November 21 | do | 7.66 | .20 | 1.01 | 1.5 |
| November 23 | do | 7.48 | .21 | 1.00 | 1.55 |
| December 5 | do | 7.57 | .24 | 1.00 | 1.82 |
| December 12 | do | 7.14 | .24 | .96 | 1.73 |

### HENRIETTA MILL DITCH AT ECHO, OREG.

This ditch diverts water from the right bank of Umatilla River, 2 miles above Echo. The water was formerly used to furnish power for the Henrietta flour mill in Echo. At present a portion of the water is used for irrigation and the remainder wasted into the river below the mill.

*Discharge measurements of Henrietta mill ditch at Echo, Oreg., in 1905.*

| Date | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | W. C. Sawyer | 6.47 | 0.80 | 1.19 | 5.20 |
| August 19 | do | 5.56 | .92 | 1.14 | 5.10 |
| August 30 | Sawyer and Dillard | 3.55 | .40 | .69 | 1.42 |
| September 8 | F. C. Dillard | 2.99 | .42 | | 1.26 |
| September 23 | do | 2.95 | .60 | .79 | 1.76 |
| September 25 | do | 2.16 | .51 | .67 | 1.11 |
| October 4 | do | 1.45 | .4 | .57 | .58 |
| October 7 | do | 1.30 | .38 | .55 | .49 |
| October 9 | do | 1.09 | .38 | .52 | .41 |
| October 12 | do | 1.04 | .36 | .50 | .37 |
| October 17 | do | .79 | .33 | .43 | .26 |
| October 21 | do | .70 | .21 | .40 | .15 |
| October 23 | do | .66 | .23 | .40 | .15 |
| October 26 | do | .55 | .40 | .40 | .22 |
| October 30 | do | 3.00 | .42 | .80 | 1.27 |
| November 2 | do | 2.87 | .35 | .80 | 1.01 |
| November 7 | do | 2.75 | .30 | .77 | .83 |
| November 10 | do | 2.55 | .31 | .73 | .78 |
| November 13 | do | 2.43 | .3 | .70 | .73 |
| November 16 | do | 2.51 | .27 | .74 | .69 |
| November 21 | do | 2.5 | .26 | .70 | .64 |
| November 24 | do | 1.85 | .21 | .63 | .38 |
| December 5 | do | 1.19 | .23 | .48 | .27 |
| December 12 | do | 1.17 | .21 | .50 | .25 |
| December 21 | do | 7.38 | .77 | 1.61 | 5.66 |
| December 27 | do | 7.2 | .78 | 1.57 | 5.58 |

*Discharge measurements of Henrietta mill ditch wasteway at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 19 | W. C. Sawyer | 2.35 | 0.45 | | 1.05 |
| August 30 | Sawyer and Dillard | 2.52 | .47 | 0.53 | 1.19 |
| September 8 | | 2.06 | .39 | .44 | .8 |
| September 23 | F. C. Dillard | .49 | .37 | | .18 |
| September 23 | do | 2.19 | .44 | .50 | .96 |
| September 26 | do | 1.84 | .35 | .44 | .65 |
| October 5 | do | 1.49 | .27 | .34 | .46 |
| October 10 | do | 1.11 | .23 | .28 | .26 |
| October 13 | do | .89 | .19 | .19 | .17 |
| October 17 | do | .65 | .20 | .19 | .13 |
| October 21 | do | .55 | .18 | .12 | .10 |
| October 24 | do | .46 | .13 | .13 | .06 |
| October 30 | do | 1.98 | .38 | .45 | .75 |
| November 3 | do | 2.14 | .30 | .44 | .64 |
| November 8 | do | 1.78 | .28 | .39 | .49 |
| November 13 | do | 1.34 | .25 | .33 | .33 |
| November 16 | do | 1.56 | .19 | .38 | .30 |
| November 24 | do | 1.81 | .11 | .42 | .19 |

### WILSON & CO.'S DITCH AT ECHO, OREG.

This ditch diverts water from the right bank of Umatilla River 2 miles above Echo, just below the Henrietta mill diversion.

Measurements were made about 500 feet below the waste gate.

The ditch was dug during 1904.

*Discharge measurements of Wilson & Co.'s ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | W. C. Sawyer | 7.4 | 0.73 | 2.07 | 5.41 |
| August 19 | do | 6.58 | .76 | 1.84 | 4.99 |
| August 30 | Sawyer and Dillard | 2.43 | .20 | 1.22 | .48 |
| September 8 | F. C. Dillard | 3.25 | .39 | 1.50 | 1.26 |
| September 23 | do | 8.98 | .38 | 2.20 | 3.41 |
| September 25 | do | 8.64 | .37 | 2.19 | 3.18 |
| October 4 | do | 4.13 | .32 | 1.64 | 1.32 |
| October 7 | do | 5.00 | .33 | 1.75 | 1.66 |
| October 9 | do | 5.45 | .35 | 1.82 | 1.93 |
| October 12 | do | 5.33 | .86 | 2.80 | 4.56 |
| October 17 | do | 5.72 | .37 | 1.91 | 2.11 |
| October 21 | do | 4.73 | .32 | 1.72 | 1.52 |
| October 23 | do | 4.28 | .31 | 1.65 | 1.34 |
| October 26 | do | 4.94 | .34 | 1.77 | 1.69 |
| October 30 | do | 5.40 | .34 | 1.81 | 1.86 |
| November 2 | do | 4.57 | .32 | 1.72 | 1.47 |
| November 7 | do | 4.60 | .31 | 1.70 | 1.42 |

### ALLEN DITCH AT ECHO, OREG.

This ditch diverts water from the left bank of Umatilla River 1 mile above Echo.

During the latter portion of 1905 a portion of the water was wasted into the Pioneer ditch and some into the river.

Measurements were made one-eighth mile below the head gate.

*Discharge measurements of Allen ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 19 | W. C. Sawyer | 10.73 | 0.65 | | 6.97 |
| August 29 | Sawyer and Dillard | 14.80 | .58 | | 8.57 |
| September 8 | F. C. Dillard | 14.84 | .76 | | 11.21 |
| September 16 | do | 5.52 | .57 | 0.42 | 3.14 |
| September 19 | do | 4.97 | .62 | .41 | 3.07 |
| September 23 | do | 12.66 | 1.34 | .99 | 16.58 |
| September 25 | do | 13.30 | 1.29 | 1.0 | 17.30 |
| September 30 | Sawyer and Dillard | 15.71 | 1.47 | 1.07 | 23.13 |
| October 4 | F. C. Dillard | 15.30 | 1.42 | 1.01 | 21.64 |
| October 7 | do | 11.96 | 1.05 | .69 | 12.52 |
| October 9 | do | 11.81 | 1.0 | .68 | 11.85 |
| October 12 | do | 11.76 | 1.02 | .67 | 11.97 |
| October 17 | do | 11.05 | 1.04 | .65 | 11.51 |
| October 21 | do | 11.65 | 1.04 | .65 | 12.11 |

*Discharge measurements of Allen ditch at Echo, Oreg., in 1905*—Continued.

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| October 24 | F. C. Dillard | 11.57 | 1.05 | 0.63 | 12.17 |
| October 27 | do | 16.21 | .74 | 1.17 | 12.08 |
| October 31 | do | 15.88 | .75 | 1.15 | 11.94 |
| November 3 | do | 16.04 | .76 | 1.14 | 12.14 |
| November 8 | do | 15.88 | .74 | 1.16 | 11.70 |
| November 11 | do | 15.54 | .73 | 1.15 | 11.52 |
| November 14 | do | 15.92 | .75 | 1.17 | 11.97 |
| November 17 | do | 15.93 | .75 | 1.16 | 11.89 |
| November 21 | do | 17.06 | .68 | 1.29 | 11.55 |
| November 24 | do | 15.44 | .79 | 1.12 | 12.17 |
| December 5 | do | 25.90 | .30 | .92 | 7.76 |
| December 13 | do | 13.12 | .26 | .92 | 3.44 |
| December 21 | do | 15.89 | .97 | 1.21 | 15.40 |

*Discharge measurements of Allen ditch wasteway at Echo, Oreg., in 1905.*

| Date | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 23 | F. C. Dillard | 1.23 | 0.10 | | 0.12 |
| September 30 | Sawyer and Dillard | 2.74 | 1.18 | | 3.24 |
| October 5 | F. C. Dillard | 2.64 | 1.13 | | 2.98 |
| October 7 | do | 2.54 | .94 | | 2.40 |
| October 9 | do | 2.35 | .97 | | 2.28 |
| October 12 | do | 2.86 | 1.03 | | 2.94 |
| October 18 | do | 2.66 | .94 | 0.48 | 2.53 |
| October 21 | do | 2.58 | .90 | .48 | 2.31 |
| October 24 | do | 2.65 | .91 | .47 | 2.42 |
| October 26 | do | 1.80 | .18 | .25 | .32 |
| October 31 | do | 1.78 | .12 | .25 | .22 |
| November 2 | do | 1.79 | .21 | .36 | .37 |
| December 13 | do | 2.41 | .48 | | 1.17 |
| December 21 | do | 4.86 | 2.23 | .81 | 10.08 |
| December 27 | do | 5.21 | 1.71 | .80 | 8.89 |

### HINKLE DITCH AT ECHO, OREG.

This ditch diverts water from the left bank of Umatilla River 1 mile above Echo. The ditch was dry during August, September, and most of October. Measurements were made at a wagon bridge just below the waste gate. The waste is so arranged that water may be turned into the Allen ditch or the Allen ditch wasteway.

*Discharge measurements of Hinkle ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| October 27 | F. C. Dillard | 7.27 | 0.81 | 1.36 | 5.86 |
| October 31 | do | 7.97 | .79 | 1.39 | 6.29 |
| November 2 | do | 9.37 | .71 | 1.39 | 6.60 |
| November 8 | do | 8.24 | .69 | 1.33 | 5.71 |
| November 10 | do | 10.13 | .76 | 1.50 | 7.70 |
| November 14 | do | 11.69 | .83 | 1.52 | 9.65 |
| November 16 | do | 10.83 | .74 | 1.52 | 8.00 |
| November 21 | do | 13.69 | 1.00 | 1.74 | 13.78 |
| November 23 | do | 13.91 | .95 | 1.74 | 13.24 |
| November 30 | do | 13.57 | .93 | 1.76 | 12.69 |
| December 5 | do | 11.73 | .97 | 1.60 | 11.40 |
| December 27 | do | 13.28 | .97 | 1.71 | 12.87 |

## PIONEER DITCH AT ECHO, OREG.

This ditch diverts water from the left bank of Umatilla River west of the city of Echo. All of the water during the latter part of September, October, and November was waste from the Allen ditch. During December a small portion of the water came directly from the river. Measurements were made from the wagon bridge just below the Allen ditch wasteway.

*Discharge measurements of Pioneer ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 23 | F. C. Dillard | 6.30 | 0.66 | 0.94 | 4.14 |
| September 25 | do | 2.52 | .52 | .51 | 1.31 |
| September 30 | Sawyer and Dillard | 6.62 | .94 | 1.09 | 6.22 |
| October 5 | F. C. Dillard | 6.16 | .84 | .95 | 5.20 |
| October 7 | do | 5.05 | .69 | .84 | 3.50 |
| October 9 | do | 5.78 | .74 | .91 | 4.25 |
| October 12 | do | 7.85 | .84 | 1.09 | 6.63 |
| October 18 | do | 8.73 | .89 | 1.18 | 7.72 |
| October 21 | do | 9.26 | .84 | 1.23 | 7.74 |
| October 24 | do | 9.47 | .81 | 1.26 | 7.64 |
| October 26 | do | 3.92 | .67 | .70 | 2.62 |
| October 31 | do | 4.32 | .61 | .76 | 2.62 |
| November 2 | do | 3.10 | .52 | .60 | 1.61 |
| November 8 | do | 10.31 | .81 | 1.32 | 8.34 |
| November 10 | do | 10.28 | .83 | 1.36 | 8.52 |
| November 14 | do | 11.40 | .85 | 1.48 | 9.65 |
| November 16 | do | 9.71 | .80 | 1.34 | 7.78 |
| November 21 | do | 10.80 | .85 | 1.43 | 8.63 |
| November 23 | do | 10.66 | .86 | 1.43 | 9.13 |
| December 13 | do | 12.55 | 1.03 | 1.58 | 12.98 |
| December 21 | do | 4.42 | .58 | .74 | 2.54 |
| December 27 | do | 3.39 | .50 | .73 | 1.71 |

### MAXWELL DITCH AT ECHO, OREG.

This ditch diverts water from the left bank of Umatilla River 2 miles below Echo. Measurements were made 1,000 feet below the head gate. At a point 1 mile below the head the water is carried under the river in a siphon and the surplus wasted into the river.

*Discharge measurements of Maxwell ditch at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 8 | Sawyer and Dillard | 2.36 | 0.68 | | 1.61 |
| August 30 | F. C. Dillard | 1.68 | .39 | | .49 |
| September 8 | do | 1.09 | .91 | | .99 |
| September 16 | do | 3.02 | .96 | 0.52 | 2.89 |
| September 19 | do | 2.81 | .80 | .47 | 2.25 |
| September 25 | do | 3.22 | .92 | .52 | 2.96 |
| September 30 | Sawyer and Dillard | 6.70 | 1.48 | 1.02 | 9.90 |
| October 5 | F. C. Dillard | 8.02 | 1.70 | 1.24 | 13.65 |
| October 7 | do | 6.72 | 1.48 | 1.00 | 9.92 |
| October 9 | do | 6.34 | 1.51 | .98 | 9.61 |
| October 12 | do | 6.32 | 1.5 | .95 | 9.46 |
| October 18 | do | 5.78 | 1.43 | .89 | 8.25 |
| October 21 | do | 5.92 | 1.45 | .88 | 8.62 |
| October 24 | do | 5.73 | 1.44 | .88 | 8.25 |
| October 26 | do | 5.16 | 1.45 | .85 | 7.48 |
| October 31 | do | 4.92 | 1.28 | .75 | 6.28 |
| November 2 | do | 4.93 | 1.25 | .75 | 6.19 |
| November 8 | do | 5.00 | 1.18 | .69 | 5.92 |
| November 10 | do | 4.40 | 1.20 | .69 | 5.30 |
| November 14 | do | 4.33 | 1.21 | .69 | 5.23 |
| November 16 | do | 4.34 | 1.24 | .68 | 5.38 |
| November 21 | do | 4.07 | 1.16 | .66 | 4.72 |
| November 23 | do | 4.13 | 1.12 | .64 | 4.64 |
| December 13 | do | 2.72 | .83 | .44 | 2.26 |
| December 21 | do | 2.09 | .67 | .45 | 1.39 |
| December 27 | do | 1.97 | .57 | .33 | 1.13 |

*Discharge measurements of Maxwell ditch wasteway at Echo, Oreg., in 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| October 5 | F. C. Dillard | 1.02 |
| October 10 | do | 1.11 |
| October 13 | do | 1.21 |
| October 18 | do | 1.14 |
| October 21 | do | 1.28 |
| October 24 | do | 1.30 |
| October 26 | do | 1.40 |
| October 31 | do | 2.29 |
| November 2 | do | 2.07 |

## HERMISTON DITCH NEAR HERMISTON, OREG.

This ditch diverts water from the right bank of Umatilla River, 5 miles below Fosters, Oreg. Measurements were made just below the head-gate and below the second waste gate.

*Discharge measurements of Hermiston ditch below head-gate near Hermiston, Oreg., in 1905.*

| Date | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 9 | W. C. Sawyer | 6.53 | 0.6 | | 3.92 |
| September 15 | F. C. Dillard | 19.15 | 1.24 | | 23.83 |
| September 22 | do | 8.89 | .81 | 0.21 | 7.20 |
| September 27 | do | 11.31 | .79 | .39 | 8.99 |
| September 30 | Sawyer and Dillard | 13.02 | .86 | .48 | 11.14 |
| October 3 | F. C. Dillard | 13.35 | .88 | .49 | 11.77 |
| October 6 | do | 13.1 | .85 | .49 | 11.18 |
| October 11 | do | 13.99 | .84 | .50 | 11.80 |
| October 14 | do | 13.28 | .82 | .54 | 10.90 |
| October 20 | do | 13.86 | .89 | .50 | 12.28 |
| October 25 | do | 13.22 | .93 | .48 | 12.18 |
| October 28 | do | 12.65 | .9 | .47 | 11.38 |
| November 1 | do | 13.09 | .8 | .47 | 11.16 |
| November 3 | do | 14.31 | .78 | .53 | 11.10 |
| November 9 | do | 13.95 | .79 | .52 | 10.93 |
| November 15 | do | 14.00 | .81 | .55 | 11.30 |
| November 18 | do | 13.94 | .8 | .54 | 11.16 |
| November 22 | do | 13.83 | .77 | .54 | 10.63 |
| November 25 | do | 14.33 | .77 | .56 | 10.99 |
| December 6 | do | 14.02 | .81 | | 11.31 |
| December 14 | do | 13.82 | .77 | | 10.60 |

*Discharge measurements of Hermiston ditch below second wasteway near Hermiston, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 9 | W. C. Sawyer | 4.25 | 0.62 | | 2.73 |
| September 22 | F. C. Dillard | 4.74 | 1.30 | 0.45 | 6.17 |
| September 27 | do | 3.15 | 1.12 | .30 | 3.54 |
| September 30 | Sawyer and Dillard | 4.22 | 1.31 | .45 | 5.55 |
| October 3 | F. C. Dillard | 4.75 | 1.34 | .50 | 6.38 |
| October 6 | do | 5.50 | 1.48 | .65 | 8.17 |
| October 11 | do | 3.76 | 1.09 | .35 | 4.10 |
| October 14 | do | 2.93 | 1.01 | .28 | 2.96 |
| October 20 | do | 5.78 | 1.50 | .70 | 8.69 |
| October 25 | do | 5.69 | 1.48 | .70 | 8.42 |
| October 28 | do | 5.31 | 1.44 | .62 | 7.66 |
| November 1 | do | 4.73 | 1.21 | .50 | 5.73 |
| November 3 | do | 2.60 | .99 | .20 | 2.58 |

### BEITLE DITCH NEAR HERMISTON, OREG.

This ditch is now owned by D. C. Brownell, and diverts water from the right bank of Umatilla River west of Hermiston. Measurements were made just below the waste gate.

*Discharge measurements of Beitle ditch near Hermiston, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 9 | | 1.87 | 0.52 | | 0.96 |
| September 15 | F. C. Dillard | 1.76 | .61 | 0.71 | 1.08 |
| October 3 | do | 1.04 | .163 | .50 | .17 |
| October 11 | do | 1.35 | .40 | .63 | .54 |
| October 14 | do | 1.39 | .45 | .64 | .62 |
| October 20 | do | 2.03 | .69 | .81 | 1.40 |
| October 25 | do | .74 | .95 | .46 | .07 |

### OREGON LAND AND WATER COMPANY'S DITCH AT UMATILLA, OREG.

This ditch diverts water from the left bank of Umatilla River 2 miles above Umatilla. Measurements were made opposite the river gaging station below the upper flume and waste gate, one-fourth mile below the diversion point. The gage was read every other day by B. V. Pompella and Clyde E. Niles.

*Discharge measurements of Oregon Land and Water Company's ditch at Umatilla, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 28 | J. H. Lewis | 15.8 | 1.74 | 2.00 | 27.5 |
| March 27 | do | 14.6 | 1.56 | 1.87 | 22.9 |
| April 10 | do | 16.1 | 1.84 | 2.00 | 29.6 |
| May 12 | W. C. Sawyer | 17.6 | 2.05 | 2.13 | 36.1 |
| July 19 | do | 12.4 | 1.47 | 1.83 | 18.2 |
| September 15 | F. C. Dillard | 12.5 | 1.28 | 1.83 | 16.0 |
| September 26 | W. C. Sawyer | 10.6 | 1.19 | 1.65 | 12.7 |
| October 25 | R. S. Hall | | | .75 | 0.0 |
| November 4 | F. C. Dillard | 10.3 | .96 | 1.53 | 9.8 |
| November 9 | do | 9.2 | 1.09 | 1.54 | 9.4 |

*Daily gage height, in feet of Oregon Land and Water Company's ditch at Umatilla, Oreg., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | 1.8 | | 2.35 | 2.4 | | 1.71 | 1.68 | |
| 2 | 1.95 | | 2.0 | | | 1.73 | | | 1.53 |
| 3 | | 1.8 | | 2.15 | 2.4 | | 1.73 | 1.71 | |
| 4 | 1.9 | | 2.0 | | | 1.7 | | | 1.53 |
| 5 | | 1.8 | | 2.15 | 2.2 | | 1.75 | 1.55 | |
| 6 | 1.95 | 1.8 | 2.0 | | | 1.7 | | | 1.53 |
| 7 | | | | 2.15 | 2.0 | | 1.75 | 1.57 | |
| 8 | 1.95 | 2.0 | 2.15 | | | 1.72 | | | 1.53 |
| 9 | | | | 2.4 | 1.95 | | 1.77 | 1.57 | |
| 10 | 2.0 | 2.0 | 2.15 | | | 1.72 | | | 1.67 |
| 11 | | | | 2.4 | 1.9 | | 1.77 | 1.58 | |
| 12 | 2.0 | 2.0 | 2.15 | | | 1.72 | | | 1.67 |
| 13 | | | | 2.25 | 1.9 | | 1.77 | 1.43 | |
| 14 | 2.0 | 2.0 | 1.9 | | | 1.67 | | (a) | 1.67 |
| 15 | | | | 2.1 | 1.85 | | 1.9 | | |
| 16 | 1.85 | 2.0 | 2.15 | | | 1.75 | | | |
| 17 | | | | 2.4 | 1.85 | | 1.88 | | |
| 18 | 1.85 | 2.0 | 1.8 | | | 1.73 | | | |
| 19 | | | | 2.4 | 1.83 | | 1.86 | | |
| 20 | 1.85 | 1.95 | 2.05 | | | 1.71 | | | |
| 21 | | | | 2.4 | 1.83 | | 1.68 | | |
| 22 | 1.85 | 2.1 | 2.05 | | | 1.7 | | | |
| 23 | | | | 2.4 | 1.82 | | 1.65 | | |
| 24 | 1.9 | 2.1 | 2.4 | | | 1.7 | | | |
| 25 | | | | 2.4 | 1.8 | | 1.67 | | |
| 26 | 1.9 | 2.1 | 2.2 | | | 1.7 | | | |
| 27 | 1.87 | | | 2.35 | 1.79 | | 1.68 | | |
| 28 | 1.9 | 2.1 | 2.3 | | | 1.7 | | | |
| 29 | 1.9 | | | 2.4 | 1.81 | | 1.68 | | |
| 30 | 1.85 | 2.1 | 2.4 | | | 1.7 | | | |
| 31 | | | | | 1.8 | | | 1.53 | |

[a] Dry October 14-30.

*Station rating table for Oregon Land and Water Company's ditch at Umatilla, Oreg., from January 1 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.75 | 0.0 | 1.20 | 3.2 | 1.70 | 14.5 | 2.20 | 41.0 |
| .80 | .1 | 1.30 | 4.5 | 1.80 | 18.5 | 2.30 | 50.0 |
| .90 | .5 | 1.40 | 6.3 | 1.90 | 23.1 | 2.40 | 60.0 |
| 1.00 | 1.2 | 1.50 | 8.5 | 2.00 | 28.2 | 2.50 | 73.0 |
| 1.10 | 2.1 | 1.60 | 11.1 | 2.10 | 34.0 | | |

The above table is applicable only for open-channel conditions. It is based on ten discharge measurements made during 1905. It is well defined between gage heights 1.65 feet and 2.1 feet.

*Estimated monthly discharge of Oregon Land and Water Company's ditch at Umatilla, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 28.2 | 19.6 | 23.8 | 1,463 |
| April | 34.0 | 18.5 | 27.5 | 1,636 |
| May | 60.0 | 18.5 | 36.9 | 2,269 |
| June | 60.0 | 34.0 | 52.2 | 3,106 |
| July | 60.0 | 18.1 | 26.8 | 1,648 |
| August | 17.1 | 13.4 | 15.0 | 922 |
| September | 23.1 | 12.7 | 16.6 | 988 |
| October | 14.9 | 0 | 4.89 | 301 |
| November | 13.4 | 9.2 | 10.8 | 300 |
| The period | | | | 12,630 |

NOTE.—Mean for actual number of days recorded taken as the mean for the entire month.

### BROWNELL DITCH AT UMATILLA, OREG.

This ditch diverts water from the right bank of Umatilla River 1½ miles above Umatilla, Oreg., and a few hundred feet below the river-gaging station. Measurements were made below the Oregon Railroad and Navigation Company's sidetrack.

*Discharge measurements of Brownell ditch at Umatilla, Oreg., in 1905.*

| Date. | Hydrographer. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|
| | | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 12 | W. C. Sawyer | 7.50 | 0.73 | | 5.50 |
| September 26 | do | 3.80 | 1.03 | 1.17 | 3.90 |
| October 25 | R. S. Hall | 3.28 | .65 | 1.05 | 2.13 |
| October 28 | F. C. Dillard | 2.95 | .58 | 1.05 | 1.72 |
| November 1 | do | 2.79 | .50 | 1.02 | 1.41 |
| November 3 | do | 2.77 | .51 | 1.00 | 1.41 |
| November 9 | do | 3.06 | .64 | 1.09 | 1.95 |
| November 15 | do | 3.06 | .65 | 1.09 | 1.98 |
| November 18 | do | 3.06 | .65 | 1.09 | 1.98 |
| November 22 | do | 3.09 | .63 | 1.09 | 1.96 |
| November 25 | do | 3.08 | .64 | 1.09 | 1.98 |
| December 6 | R. S. Hall | 3.28 | .82 | 1.11 | 2.70 |
| December 14 | F. C. Dillard | 3.28 | .68 | 1.12 | 2.23 |
| December 20 | Dillard and Hall | 3.47 | .74 | 1.14 | 2.58 |

### BOWMAN DITCH AT UMATILLA, OREG.

This ditch diverts water from the right bank of Umatilla River one-half mile above Umatilla. December 20, 1905, a discharge measurement made by Dillard and Hall gave a discharge of 0.33 second-foot.

### SPRINGS IN UMATILLA RIVER VALLEY.

The following discharge measurements were made in 1905, by F. C. Dillard, of springs in Umatilla River Valley:

Gillette Springs outlet, near Echo, Oreg., October 2, 1.95 second-feet.

Cold Springs, near Hermiston, Oreg., September 27, 1.65 second-feet; October 6, 1.50 second-feet.

## WILLOW CREEK DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Willow Creek rises on the northern slopes of the western spur of the Blue Mountains and flows northwestward, entering Columbia River at Willows, Oreg.

### WILLOW CREEK NEAR ARLINGTON, OREG.

This station was established December 17, 1904. It is located at the wagon bridge at Rhea Siding, 9 miles from Arlington, Oreg. The station is maintained as a flood station and miscellaneous measurements only are made during the summer season.

The channel is curved, but in high water is fairly straight for 100 feet. Both banks are high and clean and overflow but rarely. The bed of the stream is composed of rocks and gravel and is free from vegetation and permanent. There is but one channel.

Discharge measurements are made from the bridge or by wading.

A vertical-staff gage is fastened to a bent of the bridge. During 1905 the gage was read once each day by C. H. Curtis.

*Discharge measurements of Willow Creek near Arlington, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 16 | W. C. Sawyer | 12 | 8 | 2.21 | 3.38 | 17.6 |
| March 26 | J. H. Lewis | 27 | 25 | 2.26 | 3.77 | 56 |
| April 9 | do | 24 | 28 | 2.46 | 3.85 | 69 |
| May 31 | W. C. Sawyer | 14 | 56 | 2.82 | 4.40 | 157 |
| May 31 | do | 18 | 63 | 2.98 | 4.50 | 187 |
| May 31 | do | 14 | 46 | 2.19 | 4.18 | 112 |
| August 17 | do | 5 | 1.5 | .85 | 3.00 | 1.3 |
| October 24 | Sawyer and Hall | 4 | 2.3 | 1.59 | 3.11 | 3.7 |
| December 19 | Hall and Dillard | 9 | 6.5 | 1.79 | 3.29 | 11.6 |

NOTE.—These measurements were made at different sections.

*Daily gage height, in feet, of Willow Creek near Arlington, Oreg., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Day. | Mar. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.7 | 3.8 | 2.9 | 3.75 | 3.0 | 3.0 | 17 | 3.7 | 3.4 | 3.25 | 3.0 | 2.9 | 3.0 |
| 2 | 3.7 | 4.0 | 2.8 | 3.75 | 3.0 | 3.0 | 18 | 3.7 | 3.5 | 3.25 | 3.0 | 2.9 | 3.0 |
| 3 | 3.7 | 4.1 | 2.8 | 3.7 | 3.0 | 2.8 | 19 | 3.7 | 3.4 | 3.3 | 3.0 | 2.8 | 3.1 |
| 4 | 3.6 | 4.1 | 2.9 | 3.7 | 3.0 | 2.8 | 20 | 3.8 | 3.35 | 3.3 | 3.0 | 2.8 | 3.1 |
| 5 | 3.6 | 4.0 | 2.8 | 3.7 | 3.0 | 2.8 | 21 | 3.8 | 3.35 | 3.3 | 3.0 | 2.8 | ...... |
| 6 | 3.6 | 3.95 | 2.8 | 3.7 | 3.0 | 2.9 | 22 | 3.8 | 3.3 | 3.3 | 2.95 | 2.8 | ...... |
| 7 | 3.6 | 3.9 | 2.8 | 3.55 | 2.8 | 3.0 | 23 | 3.8 | 3.1 | 3.2 | 2.9 | 2.8 | ...... |
| 8 | 3.5 | 3.9 | 2.8 | 3.45 | 2.8 | 3.0 | 24 | 3.9 | 3.0 | 3.2 | 2.8 | 2.8 | ...... |
| 9 | 3.5 | 3.85 | 2.8 | 3.45 | 2.8 | 3.0 | 25 | 4.0 | 3.0 | 3.3 | 5.4 | 2.8 | ...... |
| 10 | 3.5 | 3.85 | 2.8 | 3.45 | 3.0 | 3.0 | 26 | 3.9 | 3.0 | 3.3 | 4.9 | 2.8 | ...... |
| 11 | 3.5 | 3.85 | 2.8 | 3.4 | 2.95 | 2.9 | 27 | 3.9 | 2.9 | 3.3 | 3.6 | 2.8 | ...... |
| 12 | 3.5 | 3.8 | 2.8 | 3.4 | 2.9 | 2.9 | 28 | 3.9 | 2.9 | 3.3 | 3.45 | 2.8 | .... |
| 13 | 3.5 | 3.5 | 2.8 | 3.4 | 2.9 | 2.8 | 29 | 3.9 | 2.9 | 3.3 | 3.3 | 2.9 | .... |
| 14 | 3.5 | 3.45 | 3.5 | 3.3 | 2.9 | 3.0 | 30 | 3.9 | 2.9 | 3.3 | 3.0 | 2.9 | .... |
| 15 | 3.6 | 3.45 | 3.5 | 3.2 | 2.9 | 3.0 | 31 | 3.9 | ...... | 4.33 | ...... | 3.0 | .. |
| 16 | 3.6 | 3.4 | 3.3 | 3.2 | 2.9 | 3.0 | | | | | | | |

*Station rating table for Willow Creek near Arlington, Oreg., from March 1 to August 20, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 2.80 | 0.2 | 3.50 | 28 | 4.20 | 120 | 4.90 | 299 |
| 2.90 | .6 | 3.60 | 38 | 4.30 | 139 | 5.00 | 333 |
| 3.00 | 1.3 | 3.70 | 48 | 4.40 | 160 | 5.10 | 369 |
| 3.10 | 3.8 | 3.80 | 60 | 4.50 | 183 | 5.20 | 406 |
| 3.20 | 7 | 3.90 | 73 | 4.60 | 209 | 5.30 | 445 |
| 3.30 | 13 | 4.00 | 87 | 4.70 | 237 | 5.40 | 488 |
| 3.40 | 20 | 4.10 | 103 | 4.80 | 267 | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is well defined between gage heights 3 feet and 4.5 feet. The table has been extended beyond these limits.

*Estimated monthly discharge of Willow Creek near Arlington, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 87 | 28 | 50.0 | 3,074 |
| April | 103 | .6 | 38.1 | 2,267 |
| May | 145 | .3 | 12.3 | 756 |
| June | 488 | .3 | 45.5 | 2,707 |
| July | 1.3 | .3 | .67 | 41 |
| August 1-20 | 3.8 | .3 | 1.24 | 49 |
| The period | | | | 8,894 |

## JOHN DAY RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

John Day River enters Columbia River from the south. For about 90 miles above its mouth the river flows in a northerly direction through a rolling country partly desert and partly cultivated and comprising, approximately, 2,000 square miles. This portion of the river receives a number of small tributaries, but only one of importance—Rock Creek—which joins the river a mile above the gaging station at McDonald. The river channel is for the most part several hundred feet below the level of the surrounding country, and as the river bottom is narrow very little water is used for irrigation.

In the upper section the river flows in a westerly direction and is joined by three important tributaries—North, Middle, and South forks. The first two flow in a westerly direction also, but the latter comes from the south. This upper portion of the river drains a country much of which is from 4,000 to 10,000 feet in elevation and which includes the western slopes of the Blue Mountains. The higher portions are still well timbered.

### JOHN DAY RIVER AT M'DONALD, OREG.

This station was established November 14, 1904, by W. C. Sawyer. It is located at the ferry at McDonald, 16 miles above the mouth of the river and 18 miles southwest of Arlington, Oreg.

The channel is straight for one-half mile above and below the cable. The current is swift. Both banks are high, free from vegetation, and do not overflow. The bed of the stream is composed of clean sand and gravel and is slightly shifting. There is but one channel at all stages.

Discharge measurements are made by means of a car suspended from the ferry cable. The car is provided with steel blocks and lever for passing the ferry traveler. The initial point for soundings is the face of the support on the right bank.

An inclined staff gage in two sections is fastened to old bridge timbers 183 feet upstream from the ferry cable. The lower section reads from 1 to 2 feet; the upper section reads from 2 to 11 feet. During 1905 the gage was read once each day by William Murray. The bench mark is the top of the corner stone under the southeast corner of a barn near the gage; elevation, 15.32 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, page 268.

*Discharge measurements of John Day River at McDonald, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 24 | W. C. Sawyer | 278 | 953 | 2.07 | 3.20 | 1,970 |
| March 17 | do | 285 | 1,067 | 2.48 | 3.66 | 2,653 |
| March 25 | J. H. Lewis | 300 | 1,214 | 2.89 | 4.10 | 3,504 |
| April 8 | do | 304 | 1,252 | 3.05 | 4.28 | 3,798 |
| May 10 | W. C. Sawyer | 308 | 1,393 | 3.59 | 4.70 | 5,006 |
| May 11 | do | 310 | 1,368 | 3.54 | 4.68 | 4,850 |
| June 1 | do | 277 | 1,047 | 2.27 | 3.58 | 2,484 |
| August 16[a] | do | 50 | 50 | 2.14 | 1.25 | 107 |
| August 17[a] | do | 58 | 48 | 2.29 | 1.25 | 109 |
| October 23 | Sawyer and Hall | 258 | 578 | .60 | 1.75 | 350 |
| October 24 | W. C. Sawyer | 258 | 556 | .60 | 1.73 | 336 |

[a] Made at different section.

*Daily gage height, in feet, of John Day River at McDonald, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.8 | 3.45 | 3.8 | 3.9 | 3.55 | 2.5 | 1.35 | 1.2 | 1.5 | 1.85 | 1.9 |
| 2 | 2.85 | 2.7 | 3.5 | 3.75 | 4.05 | 3.55 | 2.37 | 1.35 | 1.2 | 1.52 | 1.8 | 1.85 |
| 3 | 2.5 | 2.6 | 3.53 | 3.92 | 4.0 | 3.55 | 2.3 | 1.3 | 1.2 | 1.6 | 1.8 | 1.8 |
| 4 | 2.3 | 2.55 | 3.7 | 4.15 | 4.2 | 3.57 | 2.23 | 1.35 | 1.2 | 1.6 | 1.7 | 1.8 |
| 5 | 2.3 | 2.45 | 3.8 | 4.1 | 4.55 | 3.65 | 2.2 | 1.4 | 1.2 | 1.6 | 1.7 | 1.8 |
| 6 | 2.25 | 2.45 | 3.8 | 4.08 | 4.55 | 3.53 | 2.1 | 1.35 | 1.2 | 1.55 | 1.7 | 1.95 |
| 7 | 2.2 | 2.4 | 3.75 | 4.15 | 4.5 | 3.45 | 2.02 | 1.35 | 1.2 | 1.65 | 1.75 | 1.9 |
| 8 | 2.0 | 2.3 | 3.7 | 4.3 | 4.45 | 3.37 | 2.0 | 1.35 | 1.2 | 1.6 | 1.75 | 1.85 |
| 9 | 1.9 | 2.4 | 3.6 | 4.35 | 4.43 | 3.3 | 1.93 | 1.35 | 1.2 | 1.55 | 1.75 | 1.8 |
| 10 | 1.95 | 2.3 | 3.52 | 4.45 | 4.77 | 3.2 | 1.9 | 1.3 | 1.2 | 1.55 | 1.75 | 1.8 |
| 11 | 1.8 | 2.3 | 3.48 | 4.4 | 4.63 | 3.2 | 1.8 | 1.3 | 1.2 | 1.6 | 1.7 | 1.75 |
| 12 | 1.8 | 2.2 | 3.5 | 4.2 | 4.52 | 3.15 | 1.75 | 1.3 | 1.25 | 1.62 | 1.7 | 1.65 |
| 13 | 1.7 | 2.1 | 3.5 | 4.02 | 4.3 | 3.12 | 1.7 | 1.25 | 1.25 | 1.65 | 1.75 | 1.6 |
| 14 | 1.7 | 1.9 | 3.52 | 3.92 | 4.15 | 3.13 | 1.67 | 1.25 | 1.48 | 1.65 | 1.75 | 1.7 |
| 15 | 1.8 | 1.7 | 3.63 | 3.8 | 4.05 | 3.02 | 1.65 | 1.25 | 1.65 | 1.65 | 1.75 | 1.65 |
| 16 | 1.8 | 1.8 | 3.7 | 3.7 | 3.97 | 2.9 | 1.63 | 1.2 | 1.4 | 1.65 | 1.75 | 1.6 |
| 17 | 2.1 | 1.9 | 3.65 | 3.75 | 3.9 | 2.83 | 1.6 | 1.2 | 1.35 | 1.65 | 1.7 | 1.7 |
| 18 | 2.6 | 2.1 | 3.72 | 3.75 | 3.95 | 2.78 | 1.6 | 1.2 | 1.3 | 1.7 | 1.7 | 1.85 |
| 19 | 2.6 | 2.25 | 4.03 | 3.7 | 4.08 | 2.75 | 1.6 | 1.2 | 1.3 | 1.7 | 1.7 | 1.85 |
| 20 | 2.5 | 2.8 | 4.0 | 3.7 | 3.97 | 2.75 | 1.55 | 1.2 | 1.3 | 1.7 | 1.7 | 1.9 |
| 21 | 2.4 | 2.6 | 3.9 | 3.8 | 3.85 | 2.62 | 1.55 | 1.2 | 1.3 | 1.75 | 1.7 | 1.9 |
| 22 | 2.5 | 3.1 | 4.2 | 3.93 | 3.8 | 2.53 | 1.5 | 1.2 | 1.3 | 1.8 | 1.8 | 1.88 |
| 23 | 2.4 | 3.3 | 4.3 | 3.92 | 3.75 | 2.45 | 1.47 | 1.2 | 1.3 | 1.75 | 1.8 | 1.85 |
| 24 | 2.6 | 3.2 | 4.07 | 3.88 | 3.67 | 2.65 | 1.45 | 1.2 | 1.3 | 1.75 | 1.8 | 1.85 |

*Daily gage height, in feet, of John Day River at McDonald, Oreg., for 1905*—Continued.

| Date. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 3.5 | 3.3 | 4.0 | 3.85 | 3.6 | 2.57 | 1.42 | 1.2 | 1.3 | 1.75 | 1.8 | 1.68 |
| 26 | 3.5 | 3.25 | 4.08 | 3.9 | 3.5 | 2.5 | 1.4 | 1.2 | 1.35 | 1.75 | 1.7 | 1.65 |
| 27 | 3.4 | 3.37 | 4.0 | 4.0 | 3.4 | 2.68 | 1.4 | 1.2 | 1.35 | 1.75 | 1.65 | 1.75 |
| 28 | 3.2 | 3.5 | 4.27 | 4.45 | 3.35 | 2.6 | 1.37 | 1.2 | 1.4 | 1.8 | 1.6 | 1.88 |
| 29 | 3.3 | ....... | 4.1 | 4.17 | 3.43 | 2.6 | 1.35 | 1.2 | 1.4 | 1.85 | 1.7 | 1.9 |
| 30 | 3.2 | ....... | 3.95 | 3.98 | 3.4 | 2.5 | 1.35 | 1.2 | 1.5 | 1.9 | 1.9 | 1.85 |
| 31 | 3.3 | ....... | 3.88 | ....... | 4.05 | ....... | 1.35 | 1.2 | ....... | 1.9 | ....... | 1.8 |

**Note.**—During the frozen period the ice was kept clear for several hundred feet above and below gage

*Station rating table for John Day River at McDonald, Oreg., from November 14, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.20 | 88 | 2.20 | 750 | 3.10 | 1,798 | 4.00 | 3,280 |
| 1.30 | 128 | 2.30 | 852 | 3.20 | 1,930 | 4.10 | 3,486 |
| 1.40 | 170 | 2.40 | 958 | 3.30 | 2,072 | 4.20 | 3,700 |
| 1.50 | 215 | 2.50 | 1,070 | 3.40 | 2,219 | 4.30 | 3,922 |
| 1.60 | 266 | 2.60 | 1,183 | 3.50 | 2,375 | 4.40 | 4,154 |
| 1.70 | 326 | 2.70 | 1,300 | 3.60 | 2,539 | 4.50 | 4,400 |
| 1.80 | 396 | 2.80 | 1,420 | 3.70 | 2,711 | 4.60 | 4,659 |
| 1.90 | 474 | 2.90 | 1,543 | 3.80 | 2,892 | 4.70 | 4,930 |
| 2.00 | 560 | 3.00 | 1,670 | 3.90 | 3,082 | 4.80 | 5,218 |
| 2.10 | 652 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904-5. It is well defined between gage heights 1.25 feet and 4.75 feet.

*Estimated monthly discharge of John Day River at McDonald, Oreg., for 1904 and 1905.*

[Drainage area, 8,000 square miles.]

| Month. | Discharge in second-feet. | | | Total in acre-feet | Run-off. | |
|---|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | | Second-feet per square mile. | Depth in inches. |
| 1904. | | | | | | |
| November 14-30 | 516 | 326 | 456 | 15,380 | 0.057 | 0.036 |
| December | 569 | 295 | 489 | 30,070 | .061 | .070 |
| 1905. | | | | | | |
| January | 2,375 | 326 | 1,093 | 67,200 | 0.137 | 0.158 |
| February | 2,375 | 326 | 1,181 | 65,590 | .148 | .154 |
| March | 3,922 | 2,296 | 2,921 | 179,600 | .365 | .421 |
| April | 4,275 | 2,711 | 3,296 | 196,100 | .412 | .460 |
| May | 5,130 | 2,145 | 3,395 | 208,700 | .424 | .489 |
| June | 2,624 | 1,014 | 1,705 | 101,500 | .213 | .238 |
| July | 1,070 | 149 | 391 | 24,040 | .049 | .056 |
| August | 170 | 88 | 112 | 6,887 | .014 | .016 |
| September | 295 | 88 | 129 | 7,676 | .016 | .018 |
| October | 474 | 215 | 318 | 19,550 | .040 | .046 |
| November | 474 | 266 | 355 | 21,120 | .044 | .049 |
| December | 516 | 266 | 397 | 24,410 | .050 | .058 |
| The year | 5,130 | 88 | 1,274 | 922,400 | .159 | 2.16 |

**Note.**—No correction made for ice conditions.

## ROCK CREEK NEAR ARLINGTON, OREG.

Rock Creek drains a high, rolling country containing very little timber. This station was established February 25, 1905. It is located at the highway bridge at Rockville station, Oreg., on the Condon branch of the Oregon Railroad and Navigation Company's line, and is about 6 miles above the mouth of Rock Creek and about 20 miles from Arlington, Oreg.

The channel is straight for 75 feet above and 100 feet below the station. The current is moderate above and sluggish below. The right bank is high and clean. Some water crosses the road at the left bank during very high water. The bed of the stream is composed of sand and gravel and is free from vegetation and permanent. There is but one channel at all stages.

Discharge measurements are made from the upstream side of the single-span wooden bridge. The initial point for soundings is the face of the right abutment.

The elevation of the water surface is determined by measuring down by means of a graduated rod. Between February 25 and August 19, 1905, gage-height observations were taken once each day by W. A. Nugent. The bench mark is the top of a projecting beam from the upstream side of the bridge, at the left bank, marked with black paint; elevation, 15.00 feet above the datum of the gage.

*Discharge measurements of Rock Creek near Arlington, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 25 | W. C. Sawyer | 45 | 77 | 2.61 | 6.81 | 201 |
| March 18 | do | 29 | 37 | 1.24 | 5.77 | 46 |
| March 26[a] | J. H. Lewis | 35 | 74 | 2.10 | 6.91 | 155 |
| April 8 | do | 35 | 49 | 1.70 | 6.15 | 83 |
| May 10 | W. C. Sawyer | 30 | 38 | 1.03 | 5.85 | 39 |
| August 17 | do | | | | | .0 |
| October 24 | do | | | | 5.07 | .3 |
| December 5 | R. S. Hall | | | | 5.06 | [b].1 |

[a] Made at different section.

[b] Estimated.

*Daily gage height, in feet, of Rock Creek near Arlington, Oreg., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|
| 1 | | 6.2 | 6.25 | 5.3 | 5.8 | 5.3 | 5.0 |
| 2 | | 6.1 | 6.25 | 5.45 | 5.6 | 5.2 | 5.3 |
| 3 | | 6.2 | 6.65 | 5.4 | 5.55 | 5.05 | 5.05 |
| 4 | | 6.15 | 6.45 | 5.45 | 5.4 | 5.0 | 5.0 |
| 5 | | 6.15 | 6.4 | 5.55 | 5.4 | 5.05 | 5.0 |
| 6 | | 6.15 | 6.3 | 5.6 | 5.4 | 5.05 | 5.0 |
| 7 | | 6.0 | 6.15 | 5.6 | 5.4 | 5.05 | 5.0 |
| 8 | | 5.95 | 6.1 | 5.6 | 5.35 | 5.05 | 5.0 |
| 9 | | 5.9 | 6.05 | 5.55 | 5.35 | 5.1 | 5.0 |
| 10 | | 5.8 | 6.1 | 5.85 | 5.3 | 5.1 | 5.0 |
| 11 | | 5.7 | 6.05 | 5.83 | 5.3 | 5.05 | 5.0 |
| 12 | | 5.7 | 5.95 | 5.75 | 5.25 | 5.05 | 5.0 |
| 13 | | 5.65 | 5.85 | 5.7 | 5.25 | 5.05 | 4.95 |
| 14 | | 5.75 | 5.85 | 5.7 | 5.2 | 5.05 | 4.95 |
| 15 | | 5.7 | 5.8 | 5.6 | 5.2 | 5.05 | 4.95 |
| 16 | | 5.7 | 5.8 | 5.55 | 5.1 | 5.0 | 4.95 |
| 17 | | 5.65 | 5.8 | 5.5 | 5.1 | 5.0 | 4.95 |
| 18 | | 5.75 | 5.75 | 5.5 | 5.1 | 5.0 | 5.1 |

*Daily gage height, in feet, of Rock Creek near Arlington, Oreg., for 1905*—Continued.

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. |
|---|---|---|---|---|---|---|---|
| 19 | | 6.1 | 5.7 | 5.5 | 5.15 | 5.0 | 5.0 |
| 20 | | 6.1 | 5.7 | 5.45 | 5.05 | 5.0 | ........ |
| 21 | | 6.1 | 5.7 | 5.45 | 5.05 | 5.0 | ........ |
| 22 | | 6.65 | 5.65 | 5.4 | 5.05 | 5.0 | ........ |
| 23 | | 6.4 | 5.7 | 5.4 | 5.05 | 5.0 | ........ |
| 24 | | 6.78 | 5.7 | 5.45 | 5.05 | 5.0 | ........ |
| 25 | 6.8 | 7.0 | 5.6 | 5.45 | 5.05 | 4.95 | ........ |
| 26 | 6.2 | 6.7 | 5.4 | 5.45 | 5.2 | 4.95 | ........ |
| 27 | 6.25 | 7.0 | 5.4 | 5.45 | 5.5 | 4.95 | ........ |
| 28 | 6.15 | 6.6 | 5.45 | 5.4 | 5.35 | 4.95 | ........ |
| 29 | ........ | 6.45 | 5.4 | 5.35 | 5.3 | 5.0 | ........ |
| 30 | ........ | 6.35 | 5.3 | 5.35 | 5.35 | 5.0 | ........ |
| 31 | ........ | 6.2 | ........ | 5.3 | ........ | 5.0 | ........ |

*Station rating table for Rock Creek near Arlington, Oreg., from February 25 to August 19, 1905*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 5.00 | 0 | 5.60 | 28 | 6.10 | 76 | 6.60 | 165 |
| 5.10 | 2 | 5.70 | 36 | 6.20 | 88 | 6.70 | 178 |
| 5.20 | 6 | 5.80 | 45 | 6.30 | 102 | 6.80 | 202 |
| 5.30 | 10 | 5.90 | 54 | 6.40 | 118 | 6.90 | 228 |
| 5.40 | 15 | 6.00 | 64 | 6.50 | 136 | 7.00 | 256 |
| 5.50 | 21 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905. It is fairly well defined.

*Estimated monthly discharge of Rock Creek near Arlington, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March | 256 | 32 | 93.2 | 5,731 |
| April | 167 | 10 | 57.5 | 3,422 |
| May | 50 | 10 | 22.7 | 1,396 |
| June | 45 | 1 | 10.2 | 607 |
| July | 10 | 0 | .97 | 60 |

## DESCHUTES RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Deschutes River rises on the eastern slopes of the Cascade Mountains, in Klamath County, Oreg., and flows northward, entering Columbia River at Deschutes, Oreg. Its principal tributaries are West Fork, Squaw Creek, and Spring River from the west, and Crooked River and Willow and Trout creeks from the east.

## DESCHUTES RIVER NEAR BEND, OREG.

This station was established December 22, 1904, by W. C. Sawyer. It is located at the wagon bridge known as Sizemore's bridge, 1¼ miles south of Bend, Oreg.

The channel is straight for 300 feet above and below the station. The current is swift and both banks are high. The left bank is subject to overflow at extreme high water. The bed of the stream is composed of rock and gravel and is free from vegetation and permanent. There is but one channel at all stages.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is a point marked with black paint at the west end of the bridge, downstream side.

A staff gage is fastened vertically to the sixteenth bent of the bridge, 335 feet from the initial point for soundings. During 1905 the gage was read once each day by Dr. W. S. Nichol, who was paid by the Deschutes Irrigation and Power Company. The bench mark is a copper bolt cemented in a large bowlder near the edge of the water, about 100 feet above the east end of the bridge; elevation, 5.20 feet above the datum of the gage.

A description of this station, with gage heights and discharge data, is contained in Water-Supply Paper No. 135, United States Geological Survey, page 269.

*Discharge measurements of Deschutes River near Bend, Oreg., in 1905.*

| Date | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| February 7 | I. Landes | 375 | 828 | 2.54 | 2.00 | 2,100 |
| March 6 | do | 375 | 828 | 2.63 | 1.95 | 2,166 |
| April 20 | do | 375 | 797 | 2.57 | 1.90 | 2,050 |
| May 21 | do | 375 | 706 | 2.67 | 1.69 | 1,887 |
| August 10 | do | 375 | 654 | 2.43 | 1.55 | 1,590 |
| September 22 | do | 370 | 623 | 2.43 | 1.46 | 1,516 |
| October 27 | do | 370 | 634 | 2.35 | 1.50 | 1,490 |
| November 15 | do | 370 | 600 | 2.24 | 1.40 | 1,346 |
| December 7 | do | 370 | 597 | 2.02 | 1.40 | 1,209 |

*Daily gage height, in feet, of Deschutes River near Bend, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.0 | 2.1 | 1.9 | 2.0 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 |
| 2 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 |
| 3 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 |
| 4 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 5 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 6 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 7 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 8 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 9 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 10 | 2.0 | 2.0 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 11 | 2.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 12 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 13 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.4 | 1.4 |
| 14 | 1.9 | 2.0 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| 15 | 1.9 | 2.1 | 1.9 | 1.9 | 1.9 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| 16 | 1.9 | 2.0 | 1.9 | 1.9 | 2.0 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 |
| 17 | 2.0 | 1.8 | 1.9 | 1.9 | 2.0 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 18 | 2.0 | 1.8 | 1.9 | 1.9 | 1.9 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |

*Daily gage height, in feet, of Deschutes River near Bend, Oreg., for 1905*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | 2.0 | 1.8 | 1.9 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 20 | 2.0 | 1.8 | 2.0 | 1.9 | 1.7 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 21 | 2.0 | 1.9 | 2.0 | 1.9 | 1.7 | 1.7 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 22 | 2.0 | 1.9 | 2.0 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.3 |
| 23 | 2.0 | 1.9 | 2.0 | 1.9 | 1.7 | 1.6 | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.3 |
| 24 | 2.0 | 1.9 | 2.0 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 |
| 25 | 2.0 | 1.9 | 2.0 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 26 | 2.0 | 1.9 | 2.0 | 1.8 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 27 | 2.1 | 1.9 | 2.0 | 1.8 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 28 | 2.1 | 1.9 | 2.0 | 1.8 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.4 | 1.5 |
| 29 | 2.2 | ....... | 2.0 | 1.8 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | ....... | 1.4 | 1.5 |
| 30 | 2.3 | ....... | 2.0 | 1.9 | 1.7 | 1.6 | 1.6 | 1.5 | 1.5 | ....... | 1.4 | 1.5 |
| 31 | 2.1 | ....... | 2.0 | ....... | 1.7 | ....... | 1.6 | 1.5 | ....... | ....... | ....... | 1.5 |

*Station rating table for Deschutes River near Bend, Oreg., from December 22, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet* |
| 1.30 | 1,220 | 1.60 | 1,630 | 1.90 | 2,075 | 2.20 | 2,535 |
| 1.40 | 1,350 | 1.70 | 1,775 | 2.00 | 2,225 | 2.30 | 2,695 |
| 1.50 | 1,490 | 1.80 | 1,925 | 2.10 | 2,375 | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1904-5. It is fairly well defined.

*Estimated monthly discharge of Deschutes River near Bend, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 2,695 | 2,075 | 2,240 | 137,700 |
| February | 2,375 | 1,925 | 2,161 | 120,000 |
| March | 2,225 | 2,075 | 2,133 | 131,200 |
| April | 2,225 | 1,925 | 2,060 | 122,600 |
| May | 2,225 | 1,775 | 1,959 | 120,500 |
| June | 1,775 | 1,630 | 1,712 | 101,900 |
| July | 1,630 | 1,630 | 1,630 | 100,200 |
| August | 1,630 | 1,490 | 1,531 | 94,140 |
| September | 1,490 | 1,490 | 1,490 | 88,660 |
| October[a] | 1,490 | 1,490 | 1,490 | 91,620 |
| November | 1,490 | 1,350 | 1,434 | 85,330 |
| December | 1,490 | 1,220 | 1,373 | 84,420 |
| The year | 2,695 | 1,220 | 1,768 | 1,278,000 |

[a] Discharge interpolated October 29—31.

## EAST FORK OF DESCHUTES RIVER AT ODELL, OREG.

This station was established December 25, 1904, by W. C. Sawyer. It is located at the county wagon bridge at Odell, Oreg. The drainage basin is high, composed of a pumice-stone soil, and covered largely with a growth of black pines.

The current is swift and the channel curved with both banks low and clean. The left bank is liable to overflow at high water. The bed of the stream is composed of gravel and sand and is free from vegetation and permanent. There are two or more channels at the bridge during high water and one at low and ordinary stages. There is but one channel at all stages at the foot log.

Discharge measurements are made from the bridge at all ordinary stages. At extreme high water a foot log below the bridge is used. The initial point for soundings at the bridge is a 10-penny nail driven into a log at the south end of the bridge, downstream side. The initial point at the foot log is a 10-penny nail driven into the north end of the foot log.

A staff gage is fastened to logs projecting from a milk house belonging to the observer. During 1905 the gage was read once each day by Charles Graves. The bench mark is a 60-penny nail in the base of a jack-pine tree used for a gatepost in the fence of Mr. Graves's yard; elevation, 7.87 feet above the datum of the gage.

A description of this station, with gage heights, is contained in Water-Supply Paper No. 135, pages 269–270.

*Discharge measurements of East Fork of Deschutes River at Odell, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| January 31 | I. Landes | 24 | 31.0 | 2.03 | 2.50 | 63 |
| March 9 | do | 24 | 35.7 | 1.30 | 2.45 | 56 |
| April 26 | do | 24 | 40.0 | 1.93 | 2.65 | 77 |
| April 29 | do | 25 | 39.2 | 1.89 | 2.64 | 74 |
| June 25 | do | 22 | 35.0 | 1.57 | 2.45 | 55 |
| June 25 | do | 22 | 35.0 | 1.54 | 2.45 | 54 |
| August 4 | H. W. King | 24 | 29.2 | 1.04 | 2.18 | 30.3 |
| October 6 | I. Landes | 22 | 28.1 | 1.03 | 2.15 | 29.1 |
| October 30 | do | 22 | 24.0 | 1.30 | 2.18 | 31.1 |

*Daily gage height, in feet, of East Fork of Deschutes River at Odell, Oreg., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5 | 2.4 | 2.5 | 2.5 | 2.7 | 2.6 | 2.35 | 2.1 | 2.1 | 2.18 | 2.29 | 2.3 |
| 2 | 2.65 | 2.5 | 2.5 | 2.5 | 2.65 | 2.6 | 2.3 | 2.15 | 2.1 | 2.18 | 2.05 | 2.2 |
| 3 | 2.6 | 2.7 | 2.5 | 2.5 | 2.65 | 2.6 | 2.3 | 2.15 | 2.1 | 2.15 | 1.95 | 2.2 |
| 4 | 2.65 | 2.5 | 2.5 | 2.5 | 2.6 | 2.6 | 2.65 | 2.15 | 2.1 | 2.15 | 2.18 | 2.2 |
| 5 | 2.65 | 2.5 | 2.5 | 2.5 | 2.6 | 2.6 | 2.65 | 2.15 | 2.1 | 2.15 | 2.12 | 2.18 |
| 6 | 2.6 | 2.5 | 2.5 | 2.6 | 2.6 | 2.65 | 2.65 | 2.2 | 2.1 | 2.15 | 2.0 | 2.18 |
| 7 | 2.6 | 2.3 | 2.5 | 2.55 | 2.6 | 2.65 | 2.2 | 2.25 | 2.1 | 2.25 | 2.0 | 2.18 |
| 8 | 2.5 | 2.6 | 2.5 | 2.55 | 2.7 | 2.6 | 2.1 | 2.15 | 2.1 | 2.3 | 2.02 | 2.2 |
| 9 | 2.6 | 2.65 | 2.5 | 2.55 | 2.8 | 2.6 | 2.2 | 2.18 | 2.1 | 2.3 | 2.05 | 2.2 |
| 10 | 2.5 | 2.65 | 2.5 | 2.5 | 2.7 | 2.65 | 2.15 | 2.18 | 2.1 | 2.25 | 2.05 | 2.18 |
| 11 | 2.5 | 2.58 | 2.5 | 2.5 | 2.7 | 2.6 | 2.2 | 2.2 | 2.1 | 2.2 | 2.03 | 2.18 |
| 12 | 2.6 | 2.6 | 2.5 | 2.5 | 2.65 | 2.6 | 2.2 | 2.15 | 2.1 | 2.2 | 1.95 | 2.18 |
| 13 | 2.65 | 2.7 | 2.55 | 2.5 | 2.6 | 2.6 | 2.2 | 2.15 | 2.1 | 2.18 | 2.25 | 2.2 |
| 14 | 2.7 | 2.7 | 2.55 | 2.5 | 2.6 | 2.6 | 2.2 | 2.15 | 2.1 | 2.18 | 2.3 | 2.4 |
| 15 | 2.9 | 2.8 | 2.5 | 2.55 | 2.6 | 2.6 | 2.25 | 2.18 | 2.1 | 2.18 | 2.2 | 2.4 |

*Daily gage height, in feet, of East Fork of Deschutes River at Odell, Oreg., for 1905*—Cont'd.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 3.1 | 2.7 | 2.5 | 2.55 | 2.6 | 2.55 | 2.2 | 2.18 | 2.1 | 2.2 | 2.2 | 2.4 |
| 17 | 2.9 | 2.7 | 2.5 | 2.5 | 2.7 | 2.5 | 2.25 | 2.13 | 2.1 | 2.2 | 2.1 | 2.4 |
| 18 | 2.8 | 2.8 | 2.55 | 2.7 | 2.7 | 2.5 | 2.2 | 2.15 | 2.1 | 2.2 | 2.1 | 2.3 |
| 19 | 2.7 | 2.8 | 2.5 | 2.5 | 2.7 | 2.5 | 2.2 | 2.15 | 2.1 | 2.2 | 2.1 | 2.3 |
| 20 | 2.7 | 2.9 | 2.55 | 2.5 | 2.7 | 2.5 | 2.2 | 2.13 | 2.1 | 2.18 | 2.1 | 2.3 |
| 21 | 2.7 | 2.8 | 2.6 | 2.52 | 2.7 | 2.5 | 2.2 | 2.12 | 2.1 | 2.18 | 2.15 | 1.9 |
| 22 | 2.7 | 2.7 | 2.65 | 2.5 | 2.65 | 2.4 | 2.15 | 2.11 | 2.1 | 2.18 | 2.0 | 2.9 |
| 23 | 2.7 | 2.7 | 2.55 | 2.55 | 2.6 | 2.45 | 2.15 | 2.11 | 2.1 | 2.18 | 1.9 | 2.6 |
| 24 | 2.7 | 2.7 | 2.6 | 2.55 | 2.6 | 2.45 | 2.15 | 2.11 | 2.1 | 2.18 | 1.8 | 2.9 |
| 25 | 2.7 | 2.6 | 2.65 | 2.55 | 2.6 | 2.4 | 2.15 | 2.11 | 2.1 | 2.18 | 1.85 | 2.9 |
| 26 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.4 | 2.1 | 2.11 | 2.1 | 2.2 | 1.9 | 2.9 |
| 27 | 2.6 | 2.5 | 2.65 | 2.7 | 2.6 | 2.4 | 2.1 | 2.11 | 2.13 | 2.2 | 2.1 | 2.9 |
| 28 | 2.6 | 2.5 | 2.6 | 2.7 | 2.6 | 2.4 | 2.1 | 2.11 | 2.15 | 2.2 | 2.1 | 2.0 |
| 29 | 2.7 | ....... | 2.5 | 2.7 | 2.6 | 2.35 | 2.0 | 2.11 | 2.15 | 2.19 | 2.1 | 1.9 |
| 30 | 2.5 | ....... | 2.8 | 2.65 | 2.6 | 2.35 | 2.1 | 2.11 | 2.18 | 2.18 | 2.1 | 1.9 |
| 31 | 2.5 | ....... | 2.5 | ....... | 2.6 | ....... | 2.1 | 2.11 | ....... | 2.18 | ....... | 1.8 |

NOTE.—Ice conditions, January 10 to February 28.

*Station rating table for East Fork of Deschutes River at Odell, Oreg., from December 26, 1904, to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.80 | 10 | 2.20 | 32 | 2.60 | 70 | 2.90 | 104 |
| 1.90 | 14 | 2.30 | 41 | 2.70 | 81 | 3.00 | 117 |
| 2.00 | 19 | 2.40 | 50 | 2.80 | 92 | 3.10 | 131 |
| 2.10 | 25 | 2.50 | 60 | | | | |

The above table is applicable only for open-channel conditions. It is based on nine discharge measurements made during 1905. It is well defined between gage heights 2.1 feet and 2.7 feet.

*Estimated monthly discharge of East Fork of Deschutes River at Odell, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| January | 131 | 60 | 76.6 | 4,710 |
| February | 104 | 41 | 74.0 | 4,110 |
| March | 92 | 60 | 64.7 | 3,978 |
| April | 81 | 60 | 65.4 | 3,892 |
| May | 92 | 70 | 74.7 | 4,593 |
| June | 76 | 46 | 62.8 | 3,737 |
| July | 76 | 19 | 35.1 | 2,158 |
| August | 36 | 25 | 28.0 | 1,722 |
| September | 31 | 25 | 25.5 | 1,517 |
| October | 41 | 28 | 31.9 | 1,962 |
| November | 41 | 10 | 23.6 | 1,404 |
| December | 104 | 10 | 45.6 | 2,804 |
| The year | 131 | 10 | 50.7 | 36,590 |

NOTE.—No correction made for ice conditions.

## DESCHUTES RIVER NEAR LAVA, OREG.

This station was established February 17, 1905. It is located about 1 mile north of Lava, Oreg. The river has its source in Crescent Lake, receives the waters of East Fork about 30 miles above the station, and joins West Fork, which is larger and is locally known as Big River, a short distance below the station. A considerable portion of the basin is timbered.

The channel is straight for 200 feet above and 100 feet below the station. The current is swift. Both banks are high and clean. The bed of the stream is composed of clay and is free from vegetation and permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the center of the mud sill under the shear legs of the cable support on the east bank of the river.

An inclined staff gage is fastened to the right bank. During 1905 the gage was read once each day by Mrs. C. B. Allen. The bench mark is a copper bolt set in the base of a large jack-pine tree about 75 feet below the cable and near the east end of the wagon bridge; elevation, 11.38 feet above the datum of the gage.

*Discharge measurements of Deschutes River near Lava, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 2 | I. Landes | 82 | 195 | 1.47 | 6.44 | 286 |
| April 24 | do | 82 | 183 | 1.52 | 6.20 | 277 |
| May 23 | do | 82 | 182 | 1.48 | 6.34 | 270 |
| June 23 | do | 82 | 169 | 1.17 | 6.00 | 198 |
| June 23 | do | 82 | 170 | 1.22 | 6.00 | 208 |
| August 9 | do | 79 | 125 | .83 | 5.29 | 104 |
| November 18 | do | 51 | 110 | .90 | 5.00 | 100 |
| December 8 | do | 51 | 107 | .92 | 5.08 | [a] 107 |

[a] Narrow strip of ice along each bank.

*Daily gage height, in feet, of Deschutes River near Lava, Oreg., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 6.45 | 6.55 | 6.35 | 6.3 | 5.95 | 5.4 | 5.05 | 5.15 | 5.15 | 5.1 |
| 2 | | 6.45 | 6.55 | 6.4 | 6.3 | 5.85 | 5.4 | 5.05 | 5.2 | 5.1 | 5.1 |
| 3 | | 6.45 | 6.55 | 6.45 | 6.4 | 5.85 | 5.4 | 5.05 | 5.1 | 5.05 | 5.1 |
| 4 | | 6.5 | 6.55 | 6.5 | 6.45 | 5.8 | 5.3 | 5.0 | 5.1 | 5.05 | 5.1 |
| 5 | | 6.5 | 6.5 | 6.4 | 6.4 | 5.8 | 5.3 | 5.0 | 5.1 | 5.05 | 5.0 |
| 6 | | 6.5 | 6.5 | 6.35 | 6.4 | 5.75 | 5.3 | 5.0 | 5.1 | 5.0 | 5.0 |
| 7 | | 6.5 | 6.45 | 6.3 | 6.4 | 5.7 | 5.3 | 5.0 | 5.15 | 5.0 | 4.95 |
| 8 | | 6.5 | 6.45 | 6.4 | 6.35 | 5.7 | 5.3 | 5.0 | 5.2 | 5.0 | 5.15 |
| 9 | | 6.45 | 6.45 | 6.45 | 6.3 | 5.65 | 5.3 | 5.0 | 5.3 | 5.0 | 4.9 |
| 10 | | 6.4 | 6.45 | 6.5 | 6.3 | 5.6 | 5.3 | 5.0 | 5.3 | 5.0 | 5.0 |
| 11 | | 6.4 | 6.4 | 6.55 | 6.25 | 5.55 | 5.3 | 5.0 | 5.2 | 5.0 | 5.0 |
| 12 | | 6.4 | 6.3 | 6.55 | 6.25 | 5.55 | 5.3 | 5.0 | 5.2 | 5.0 | 5.0 |
| 13 | | 6.4 | 6.3 | 6.5 | 6.3 | 5.55 | 5.25 | 5.05 | 5.15 | 5.0 | 5.0 |
| 14 | | 6.4 | 6.3 | 6.4 | 6.2 | 5.55 | 5.2 | 5.05 | 5.15 | 4.9 | 5.0 |
| 15 | | 6.45 | 6.3 | 6.35 | 6.2 | 5.5 | 5.2 | 5.05 | 5.15 | 4.85 | 5.05 |
| 16 | | 6.5 | 6.35 | 6.4 | 6.15 | 5.5 | 5.2 | 5.05 | 5.2 | 4.9 | 5.1 |
| 17 | 6.3 | 6.5 | 6.35 | 6.3 | 6.15 | 5.5 | 5.2 | 5.05 | 5.2 | 5.0 | 5.1 |
| 18 | 6.32 | 6.5 | 6.35 | 6.3 | 6.1 | 5.5 | 5.2 | 5.05 | 5.25 | 5.0 | 5.1 |
| 19 | 6.4 | 6.5 | 6.35 | 6.3 | 6.1 | 5.5 | 5.2 | 5.05 | 5.2 | 5.1 | 5.15 |

*Daily gage height, in feet, of Deschutes River near Lava, Oreg., for 1905*—Continued.

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 6.7 | 6.55 | 6.3 | 6.3 | 6.1 | 5.45 | 5.15 | 5.0 | 5.2 | 5.1 | 5.2 |
| 21 | 6.75 | 6.65 | 6.3 | 6.3 | 6.05 | 5.4 | 5.15 | 5.0 | 5.2 | 5.1 | 5.3 |
| 22 | 6.6 | 6.75 | 6.25 | 6.35 | 6.0 | 5.4 | 5.1 | 5.0 | 5.2 | 5.0 | 5.2 |
| 23 | 6.65 | 6.75 | 6.25 | 6.35 | 6.0 | 5.4 | 5.1 | 5.0 | 5.15 | 5.0 | 5.05 |
| 24 | 6.4 | 6.7 | 6.2 | 6.3 | 6.0 | 5.4 | 5.1 | 5.0 | 5.15 | 5.0 | 5.15 |
| 25 | 6.5 | 6.7 | 6.2 | 6.25 | 6.05 | 5.4 | 5.1 | 5.0 | 5.15 | 5.0 | 5.15 |
| 26 | 6.5 | 6.75 | 6.2 | 6.35 | 6.0 | 5.35 | 5.1 | 5.0 | 5.15 | 5.0 | 5.25 |
| 27 | 6.45 | 6.75 | 6.2 | 6.3 | 6.1 | 5.3 | 5.1 | 5.0 | 5.15 | 5.1 | 5.3 |
| 28 | 6.4 | 6.8 | 6.2 | 6.35 | 6.05 | 5.3 | 5.1 | 5.05 | 5.15 | 5.1 | 5.3 |
| 29 | ........ | 6.75 | 6.25 | 6.35 | 6.0 | 5.3 | 5.05 | 5.05 | 5.15 | 5.0 | 5.3 |
| 30 | ........ | 6.65 | 6.3 | 6.35 | 6.0 | 5.3 | 5.05 | 5.1 | 5.15 | 5.0 | 5.3 |
| 31 | ........ | 6.55 | ........ | 6.3 | ........ | 5.3 | 5.05 | ........ | 5.15 | ........ | 5.3 |

*Station rating table for Deschutes River near Lava, Oreg., from January 17 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 4.80 | 76 | 5.40 | 125 | 5.90 | 188 | 6.40 | 283 |
| 4.90 | 82 | 5.50 | 135 | 6.00 | 205 | 6.50 | 305 |
| 5.00 | 89 | 5.60 | 147 | 6.10 | 223 | 6.60 | 329 |
| 5.10 | 97 | 5.70 | 160 | 6.20 | 242 | 6.70 | 355 |
| 5.20 | 106 | 5.80 | 173 | 6.30 | 262 | 6.80 | 382 |
| 5.30 | 115 | | | | | | |

The above table is applicable only for open-channel conditions. It is based on eight discharge measurements made during 1905. It is well defined between gage heights 5 feet and 6.5 feet.

*Estimated monthly discharge of Deschutes River near Lava, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February 17-28 | 368 | 262 | 306 | 7,283 |
| March | 382 | 283 | 319 | 19,620 |
| April | 317 | 242 | 274 | 16,300 |
| May | 317 | 252 | 278 | 17,090 |
| June | 294 | 205 | 241 | 14,340 |
| July | 196 | 115 | 141 | 8,670 |
| August | 125 | 93 | 107 | 6,579 |
| September | 97 | 89 | 90.9 | 5,409 |
| October | 115 | 97 | 100 | 6,149 |
| November | 102 | 79 | 90.6 | 5,391 |
| December | 115 | 82 | 99.2 | 6,100 |
| The period | ........ | ........ | ........ | 112,900 |

## WEST FORK OF DESCHUTES RIVER NEAR LAVA, OREG.

This station was established February 20, 1905. It is located about 1½ miles west of Lava, Oreg. This branch of the river rises in five small lakes in a high, timbered country, and as a consequence has a very uniform flow.

The channel is slightly curved and the current is swift. Both banks are low, wooded, and not liable to overflow. The bed of the stream is composed of gravel and is free from vegetation and permanent. There is but one channel at all stages.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the center of the mud sill under the shear legs of the cable support on the north bank of the river, and is marked with a brass nail.

An inclined staff gage is set on the right bank. During 1905 the gage was read once each week by David Hill. The bench mark is a 60-penny nail driven into the base of a large yellow pine near the gage; elevation, 19.33 feet above the datum of the gage.

*Discharge measurements of West Fork of Deschutes River near Lava, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| March 3 | I. Landes | 101 | 544 | 2.10 | 8.89 | 1,144 |
| April 25 | do | 100 | 517 | 2.09 | 8.59 | 1,081 |
| May 23 | do | 101 | 520 | 2.05 | 8.60 | 1,064 |
| June 23 | do | 101 | 499 | 2.07 | 8.44 | 1,033 |
| August 9 | do | 101 | 482 | 2.06 | 8.24 | 993 |
| October 8 | do | 101 | 472 | 2.09 | 8.20 | 986 |
| October 28 | do | 101 | 456 | 2.03 | 8.01 | 926 |
| November 17 | do | 100 | 444 | 2.06 | 7.87 | 917 |
| December 9 | do | 99 | 443 | 1.96 | 7.74 | 870 |
| December 27 | do | 127 | 446 | 2.02 | 7.77 | 903 |
| December 27 | do | 99 | 446 | 2.02 | 7.77 | 904 |

*Daily gage height, in feet, of West Fork of Deschutes River near Lava, Oreg., for 1905.*

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 8.9 | 8.8 | | | | | | | | |
| 2 | | 8.9 | 8.8 | 8.65 | | | | 8.15 | | | 7.8 |
| 3 | | 8.9 | 8.77 | | | 8.4 | | | | | |
| 4 | | 8.9 | 8.7 | | | | | | | 7.95 | |
| 5 | | 8.93 | 8.7 | | 8.6 | | | | | | |
| 6 | | 8.95 | | | | | | | | | |
| 7 | | 8.95 | 8.7 | | | | 8.2 | | 8.2 | | |
| 8 | | 8.92 | | | | | | | | | |
| 9 | | 8.9 | | 8.7 | | | | 8.25 | | | 7.7 |
| 10 | | 8.9 | | | | 8.3 | | | | | |
| 11 | | 8.9 | 8.6 | | | | | | | 7.9 | |
| 12 | | 8.85 | | | 8.5 | | | | | | |
| 13 | | 8.8 | | | | | 8.2 | | | | |
| 14 | | 8.8 | | | | | | | 8.05 | | |
| 15 | | 8.8 | | | | | | | | | |
| 16 | | 8.83 | | 8.6 | | | | 8.01 | | | 7.8 |
| 17 | | 8.8 | | | | 8.3 | | | | 7.9 | |
| 18 | | 8.8 | 8.6 | | | | | | | | 7.75 |
| 19 | | 8.82 | | | 8.45 | | | | | | |
| 20 | 8.8 | 8.82 | | 8.6 | | | 8.2 | | | | |

*Daily gage height, in feet, of West Fork of Deschutes River near Lava, Oreg., in 1905*—Con.

| Day. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 8.8 | 8.98 | | | | | | | 8.05 | | 7.7 |
| 22 | 8.8 | 8.98 | | 8.6 | | | | | | | |
| 23 | 8.85 | 8.9 | | | | | | 8.01 | | | 8.0 |
| 24 | 8.9 | 8.92 | | | | 8.3 | | | | | |
| 25 | 8.87 | 8.9 | 8.6 | | | | | | | 7.8 | 7.7 |
| 26 | 8.85 | 8.92 | | | 8.45 | | 8.2 | | | | |
| 27 | 8.88 | 8.95 | | | | | | | | | |
| 28 | 8.87 | 8.88 | | | | | | | 8.0 | | 7.65 |
| 29 | | 8.9 | | 8.6 | | | | | | | |
| 30 | | 8.8 | | | | | | 8.02 | | | 7.8 |
| 31 | | 8.72 | | | | 8.25 | | | | | |

*Station rating table for West Fork of Deschutes River near Lava, Oreg., from February 20 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 7.60 | 867 | 8.00 | 942 | 8.40 | 1,027 | 8.80 | 1,123 |
| 7.70 | 883 | 8.10 | 963 | 8.50 | 1,050 | 8.90 | 1,148 |
| 7.80 | 902 | 8.20 | 984 | 8.60 | 1,074 | 9.00 | 1,173 |
| 7.90 | 922 | 8.30 | 1,005 | 8.70 | 1,098 | | |

The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905. It is well defined between gage heights 7.7 feet and 8.9 feet.

*Estimated monthly discharge of West Fork of Deschutes River near Lava, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| February 20-28 | 1,148 | 1,123 | 1,135 | 20,260 |
| March | 1,168 | 1,103 | 1,142 | 70,220 |
| April | 1,123 | 1,074 | 1,083 | 64,440 |
| May | 1,098 | 1,074 | 1,081 | 66,470 |
| June | 1,074 | 1,038 | 1,050 | 62,480 |
| July | 1,027 | 994 | 1,007 | 61,920 |
| August | 984 | 984 | 984 | 60,500 |
| September | 994 | 944 | 961 | 57,180 |
| October | 984 | 942 | 958 | 58,900 |
| November | 932 | 902 | 920 | 54,740 |
| December | 942 | 875 | 895 | 55,030 |
| The period | | | | 632,100 |

NOTE.—Owing to the steady flow of the river the mean discharge for the days in each month when the gage height was recorded has been taken as the monthly mean.

## CANALS IN DESCHUTES RIVER VALLEY, OREGON.

### FINDLEY'S DITCH NEAR ROSLAND, OREG.

May 24, 1905, a discharge measurement made of this ditch by Ivan Landes gave a discharge of 3.9 second-feet.

### CENTRAL OREGON CANAL NEAR BEND, OREG.

The gage on the Central Oregon canal is vertical and attached to the south side of the flume opposite station 88 on the Pilot Butte canal. The zero of the gage is the bottom of the flume. Measurements were made in the flume. The gage was read during a portion of the year by G. A. Wilson and Z. T. Gideon.

*Discharge measurements of Central Oregon canal near Bend, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 22 | Ivan Landes | 13.2 | 15.8 | 4.40 | 1.20 | 69.5 |
| June 22 | do | 13.3 | 12.0 | 3.62 | .90 | 43.4 |
| August 10 | do | 13.3 | 7.98 | 2.71 | .60 | 21.6 |
| September 22 | do | 13.3 | 14.8 | 3.70 | 1.11 | 54.8 |
| November 16 | do | 13.3 | 15.8 | 3.74 | 1.19 | 59.2 |

*Daily gage height, in feet, of Central Oregon canal near Bend, Oreg., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | 0.98 | 0.0 | 0.6 | 0.75 | 1.15 | 1.22 | 1.3 |
| 2 | | | | .95 | 1.0 | .0 | .7 | .58 | 1.05 | 1.3 |
| 3 | | | | .95 | .85 | .7 | .7 | .82 | 1.12 | 1.3 |
| 4 | | | | 1.0 | .0 | .7 | .8 | .0 | 1.12 | 1.35 |
| 5 | | | | .95 | .0 | .7 | .78 | .42 | 1.22 | 1.4 |
| 6 | | | | 1.15 | .0 | .7 | 1.1 | .85 | 1.22 | 1.38 |
| 7 | | | | .82 | .0 | .7 | 1.08 | .95 | 1.2 | 1.35 |
| 8 | | | | .32 | .0 | .7 | .78 | 1.05 | 1.1 | 1.45 |
| 9 | | | | .3 | .7 | .7 | .7 | .52 | 1.2 | 1.35 |
| 10 | | | | .45 | .83 | .7 | .65 | .85 | 1.25 | 1.35 |
| 11 | 0.52 | | | .82 | .75 | .7 | .68 | .85 | 1.25 | 1.4 |
| 12 | .52 | | | .85 | .98 | .7 | .65 | 1.15 | 1.25 | 1.4 |
| 13 | .52 | | | 1.0 | .9 | .7 | .7 | 1.15 | 1.25 | 1.15 |
| 14 | .0 | | | 1.0 | .7 | .7 | 1.2 | 1.2 | 1.25 | .85 |
| 15 | .0 | | | 1.3 | .0 | .0 | 1.2 | 1.2 | 1.25 | .9 |
| 16 | .65 | | | .82 | .7 | .7 | 1.25 | 1.0 | 1.25 | 1.4 |
| 17 | .65 | | | .8 | .6 | .7 | 1.25 | 1.0 | 1.2 | 1.5 |
| 18 | | | | .95 | .82 | .0 | 1.0 | 1.0 | 1.22 | 1.45 |
| 19 | | | | .95 | .3 | .7 | 1.0 | 1.0 | 1.3 | 1.4 |
| 20 | | | | .0 | .7 | .62 | 1.0 | 1.0 | 1.3 | 1.4 |
| 21 | | | | .0 | .7 | .52 | 1.1 | 1.0 | 1.32 | 1.4 |
| 22 | | | | .85 | .0 | .55 | 1.15 | 1.0 | 1.35 | 1.1 |
| 23 | | | | .85 | .7 | .52 | 1.12 | 1.0 | 1.35 | .4 |
| 24 | | | | .85 | .7 | .55 | 1.1 | 1.1 | .62 | .0 |
| 25 | | | | .85 | .7 | .9 | .55 | 1.1 | .48 | .0 |
| 26 | | | | .85 | .0 | 1.0 | .65 | 1.27 | 1.1 | .0 |
| 27 | | | | .85 | .35 | .85 | .95 | .1 | 1.3 | .0 |
| 28 | | | | .92 | .6 | .9 | .55 | 1.12 | 1.3 | .42 |
| 29 | | | | .85 | .0 | .9 | 1.15 | 1.05 | 1.3 | .0 |
| 30 | | | | .85 | .6 | .9 | 1.12 | 1.15 | 1.38 | .0 |
| 31 | | | | | .6 | .9 | | 1.3 | | .0 |

*Station rating table for Central Oregon canal near Bend, Oreg., for 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 0.00 | 0 | 0.70 | 28 | 1.40 | 84 | 2.00 | 153 |
| .10 | 2 | .80 | 34 | 1.50 | 94 | 2.10 | 166 |
| .20 | 5 | .90 | 41 | 1.60 | 105 | 2.20 | 180 |
| .30 | 8 | 1.00 | 48 | 1.70 | 116 | 2.30 | 194 |
| .40 | 12 | 1.10 | 56 | 1.80 | 128 | 2.40 | 209 |
| .50 | 17 | 1.20 | 65 | 1.90 | 140 | 2.50 | 224 |
| .60 | 22 | 1.30 | 74 | | | | |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is fairly well defined.

*Estimated monthly discharge of Central Oregon canal near Bend, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March (7 days) | 25 | 0 | 14.9 | 207 |
| June | 74 | 0 | 36.6 | 2,178 |
| July | 48 | 0 | 19.5 | 1,199 |
| August | 48 | 0 | 26.8 | 1,648 |
| September | 70 | 20 | 43.4 | 2,582 |
| October | 105 | 0 | 45.9 | 2,822 |
| November | 82 | 16 | 65.6 | 3,904 |
| December | 94 | 0 | 54.8 | 3,370 |
| The period | | | | 17,900 |

## PILOT BUTTE CANAL NEAR BEND, OREG.

Water is diverted from the right bank of Deschutes River about 3 miles above Bend by the Deschutes Irrigation and Power Company. About 2 miles above Bend the ditch divides, forming the Central Oregon canal on the right and the Pilot Butte canal on the left.

The gage on Pilot Butte canal is a vertical rod on the south bank at canal-survey station 88+25, a short distance below the division point and waste weir. The bench mark is a copper bolt cemented in the rock about 2 feet from the gage. Its elevation is 4.76 feet above the datum of the gage. Measurements were made during 1905 by wading. The gage was read during a portion of the year by G. A. Wilson and Z. T. Gideon, employees of the Deschutes Irrigation and Power Company.

*Discharge measurements of Pilot Butte canal near Bend, Oreg., in 1905.*

| Date. | Hydrographer | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| May 17 | Ivan Landes | 31.0 | 22.0 | 1.00 | 1.70 | 22.1 |
| June 22 | .....do | 32.0 | 40.6 | 1.52 | 2.11 | 61.7 |
| August 10 | .....do | 32.0 | 47.0 | 1.72 | 2.30 | 80.8 |
| September 22 | .....do | 31.5 | 38.7 | 1.29 | 2.03 | 49.8 |
| November 16 | .....do | 30.0 | 28.8 | 1.96 | 2.02 | 56.6 |

*Daily gage height, in feet, of Pilot Butte canal near Bend, Oreg., for 1905.*

| Day. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ........ | 1.92 | ........ | 1.1 | 0.0 | 1.4 | 2.22 | 2.25 | 2.05 | 1.65 |
| 2 | ........ | 1.78 | ........ | 1.15 | 1.25 | .7 | 2.38 | 2.22 | 2.05 | 1.65 |
| 3 | ........ | 1.78 | ........ | 1.12 | 1.25 | 1.4 | 2.38 | 1.12 | 2.05 | 1.65 |
| 4 | ........ | 1.78 | ........ | 1.15 | 1.25 | 1.4 | 2.4 | 2.25 | 2.05 | 1.8 |
| 5 | ........ | 1.78 | ........ | 1.15 | 1.25 | 1.4 | 2.4 | 2.25 | 2.05 | 1.95 |
| 6 | 1.72 | ........ | ........ | .6 | 1.25 | 1.4 | 2.3 | 2.25 | 2.05 | 1.95 |
| 7 | ........ | ........ | ........ | 1.12 | .0 | 1.4 | 2.2 | 2.25 | 2.05 | 1.95 |
| 8 | 1.72 | ........ | ........ | 1.05 | .0 | 1.4 | 2.35 | 2.25 | 2.05 | 1.8 |
| 9 | 1.73 | ........ | ........ | 1.1 | 1.25 | .0 | 2.2 | 2.25 | 2.05 | 1.95 |
| 10 | 1.73 | ........ | ........ | 1.1 | 1.16 | 1.4 | 2.15 | 2.25 | 2.05 | 1.95 |
| 11 | 1.47 | ........ | ........ | 1.1 | 1.35 | .0 | 2.2 | 2.25 | 2.05 | 1.65 |
| 12 | 1.47 | ........ | ........ | 1.1 | 1.0 | 1.4 | 2.3 | 2.25 | 2.05 | 1.6 |
| 13 | 1.47 | ........ | ........ | 1.1 | .98 | .0 | 2.25 | 2.22 | 2.05 | 1.78 |
| 14 | 1.64 | ........ | ........ | 1.1 | 1.3 | 1.4 | 2.2 | 2.25 | 2.05 | 1.95 |
| 15 | 1.64 | ........ | ........ | .55 | .0 | .35 | 2.18 | 2.25 | 2.05 | 1.6 |
| 16 | 1.76 | ........ | ........ | 1.15 | 1.2 | 1.4 | 2.2 | 2.25 | 2.05 | .8 |
| 17 | 1.76 | ........ | ........ | 1.18 | 1.35 | 1.4 | 2.22 | 2.25 | 2.05 | .0 |
| 18 | 2.0 | ........ | ........ | 1.15 | 1.05 | .0 | 2.25 | 2.18 | 2.05 | 1.85 |
| 19 | 2.0 | ........ | ........ | 1.15 | 1.12 | 1.45 | 2.25 | 2.2 | 2.05 | 1.95 |
| 20 | 1.34 | ........ | ........ | .4 | 1.4 | 1.4 | 2.25 | 2.18 | 2.05 | 1.95 |
| 21 | 1.34 | ........ | ........ | .4 | 1.4 | 1.4 | 2.2 | 2.18 | 2.05 | 1.95 |
| 22 | 1.72 | ........ | ........ | 1.25 | 0.0 | 1.38 | 2.2 | 2.12 | 2.0 | .98 |
| 23 | 1.81 | ........ | ........ | 1.25 | 1.4 | 1.38 | 2.22 | 2.1 | 2.0 | .0 |
| 24 | 1.8 | ........ | ........ | 1.25 | 1.4 | 1.4 | 2.25 | 2.1 | 2.0 | .0 |
| 25 | 1.8 | ........ | ........ | 1.25 | 1.4 | 1.35 | 2.24 | 2.1 | 1.87 | .0 |
| 26 | 1.8 | ........ | ........ | 1.25 | .8 | 1.4 | 2.22 | 2.1 | 1.82 | 1.92 |
| 27 | 1.8 | ........ | ........ | 1.25 | 1.5 | 1.38 | 2.22 | 2.1 | 2.0 | 1.95 |
| 28 | 1.92 | ........ | ........ | 1.12 | 1.35 | 1.4 | 2.3 | 2.1 | 2.0 | .98 |
| 29 | 1.92 | ........ | ........ | 1.25 | .0 | ........ | 2.25 | 2.1 | 2.0 | .0 |
| 30 | 1.92 | ........ | ........ | 1.25 | 1.4 | ........ | 2.28 | 2.05 | 2.0 | .0 |
| 31 | 1.92 | ........ | ........ | ........ | 1.4 | ........ | ........ | 2.05 | ........ | .0 |

NOTE.—Gage readings June 1 to August 28 on weir above waste gate. Length of weir 15 feet with end contractions.

*Station rating table for Pilot Butte canal near Bend, Oreg., from March 6 to December 31, 1905.*

| Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* | *Feet.* | *Second-feet.* |
| 1.00 | 2 | 1.40 | 10 | 1.80 | 30 | 2.20 | 70 |
| 1.10 | 3 | 1.50 | 14 | 1.90 | 39 | 2.30 | 81 |
| 1.20 | 5 | 1.60 | 18 | 2.00 | 49 | 2.40 | 93 |
| 1.30 | 7 | 1.70 | 23 | 2.10 | 59 | | |

The above table is applicable only for open-channel conditions. It is based on five discharge measurements made during 1905. It is well defined between gage heights 1.7 feet and 2.4 feet.

*Estimated monthly discharge of Pilot Butte canal near Bend, Oreg., for 1905.*

| Month. | Discharge in second-feet. | | | Total in acre-feet. |
|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | |
| March (26 days) | 49 | 8 | 27.2 | 1,403 |
| April (5 days) | 41 | 29 | 31.4 | 311 |
| June | 68.6 | 12.6 | 55.7 | 3,314 |
| July | 89.9 | .0 | 56.3 | 3,462 |
| August | 85.7 | .0 | 66.8 | 4,107 |
| September | 93 | 65 | 76.3 | 4,540 |
| October | 76 | 3 | 66.8 | 4,107 |
| November | 54 | 32 | 51.3 | 3,053 |
| December | 44 | .0 | 23.2 | 1,426 |
| The period | | | | 25,720 |

NOTE.—Discharge approximated March 7 and August 29–31.

### COLUMBIA SOUTHERN CANAL NEAR BEND, OREG.

This canal diverts water from the left bank of Tumallo Creek directly west of Bend, Oreg.

*Discharge measurements of Columbia Southern canal near Bend, Oreg., in 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| June 21 | Ivan Landes | 48.3 |
| August 10 | do | 69.4 |

### CARMICHAEL DITCH AT PRINEVILLE, OREG.

This ditch diverts water from Crooked River at Prineville, Oreg.

*Discharge measurements of Carmichael ditch at Prineville, Oreg., in 1905.*

| Date. | Hydrographer. | Discharge. |
|---|---|---|
| | | *Second-feet.* |
| May 18 | Ivan Landes | 34.7 |
| June 19 | do | 15.7 |
| August 11 | do | 7.1 |

## HOOD RIVER DRAINAGE BASIN.

Hood River rises on the northern slopes of Mount Hood and flows northwestward, entering Columbia River at Hood River, Oreg.

### HOOD RIVER AT WINANS CITY, OREG.

This station was established November 17, 1905, by L. R. Allen. It is located 300 feet below the junction of the main forks of the river, at Winans City, 10½ miles above Hood River post-office, Oreg.

The channel is straight for 300 feet above and below the station. Both banks are high, rocky, slightly wooded, and do not overflow. The bed of the stream is of coarse gravel and is free from vegetation and shifting. There is but one channel at all stages. The stream has much fall at all points, and the current is almost a continuous rapid.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point for soundings is a tin tag soldered to the tag wire 2.5 feet from the anchorage on the left bank.

The gage is a staff in two sections. The lower section is inclined and securely fastened to the rock and tree above. The upper section is vertical, and is fastened to an alder tree. The total height of the gage is 20 feet. It is read once each day by W. R. Winans. The bench mark is the highest point on large rock about 15 feet south of the inclined portion of the gage; elevation, 18.20 feet above the datum of the gage.

*Discharge measurements of Hood River at Winans City, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| November 17.. | L. R. Allen.......................... | 90 | 147 | 3.36 | 0.57 | 493 |
| December 23... | .....do................................ | 90 | 180 | 4.27 | 1.03 | 767 |

*Daily gage height, in feet, of Hood River at Winans City, Oreg., for 1905.*

| Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 0.7 | 9 | ...... | 1.0 | 17 | ...... | 1.8 | 25 | 0.7 | 0.7 |
| 2 | ...... | .7 | 10 | ...... | 1.0 | 18 | ...... | 1.6 | 26 | 1.3 | 1.7 |
| 3 | ...... | .7 | 11 | ...... | 1.0 | 19 | 1.5 | 1.6 | 27 | 1.0 | 1.6 |
| 4 | ...... | .7 | 12 | ...... | .9 | 20 | 1.0 | 1.4 | 28 | .9 | 1.5 |
| 5 | ...... | .8 | 13 | ...... | .8 | 21 | .8 | 1.2 | 29 | .8 | 1.3 |
| 6 | ...... | .8 | 14 | ...... | .7 | 22 | .8 | 1.2 | 30 | .7 | 1.0 |
| 7 | ...... | .9 | 15 | ...... | .7 | 23 | .8 | 1.0 | 31 | ...... | .8 |
| 8 | ...... | .9 | 16 | ...... | .7 | 24 | .7 | .8 | | | |

## WILLAMETTE RIVER DRAINAGE BASIN.

### DESCRIPTION OF BASIN.

Willamette River is formed by the junction of Coast Fork and Middle Fork near Eugene, Oreg. Coast Fork rises on the eastern slope of the Coast Range and Middle Fork rises on the western slope of the Cascade Mountains. A short distance below the junction the Willamette receives the waters of McKenzie Fork, a large stream from the east. Other tributaries of note are Santiam, Luckiamute, Molalla, and Clackamas rivers.

### MIDDLE FORK OF WILLAMETTE RIVER AT JASPER, OREG.

This station was established September 16, 1905, by L. R. Allen. It is located at Jasper Ferry, Jasper post-office, Oreg., 2 miles above Natron, and 3 miles below the mouth of Fall Creek.

The channel is straight for 800 feet above and 700 feet below the station. The current is swift. The right bank is high, covered with brush, and not liable to overflow. The left bank is lower, clear of brush, and is liable to overflow during extreme floods. The bed of the stream is composed of gravel or small bowlders and is free from vegetation and shifting. There is but one channel at all stages. The accuracy of measurements may be affected by floating logs.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point for soundings is a tin tag on the tagged wire 17 feet from the cable support on the right bank.

The gage is a vertical staff 18 feet long spiked to a tree on the right bank, 30 feet above the cable. During 1905 the gage was read once each day by W. H. Eaton. The bench mark is the top of three 30-penny nails driven into the left sill near the first vertical rod of a bridge across a small creek, 400 feet below the cable; elevation, 21.43 feet above the datum of the gage.

*Discharge measurements of Middle Fork of Willamette River at Jasper, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 16 | L. R. Allen | 322 | 652 | 1.16 | 1.25 | 758 |
| December 29 | do | 354 | 1,366 | 2.88 | 3.27 | 3,925 |

*Daily gage height, in feet, of Middle Fork of Willamette River at Jasper, Oreg., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.5 | 1.7 | 3.2 | 12 | ...... | 1.7 | 1.5 | 2.5 | 23 | 1.2 | 1.8 | 2.0 | 2.5 |
| 2 | ...... | 1.5 | 1.7 | 3.2 | 13 | ...... | 1.7 | 1.5 | 2.4 | 24 | 1.2 | 1.7 | 1.9 | 2.4 |
| 3 | ...... | 1.4 | 1.7 | 3.4 | 14 | ...... | 1.7 | 1.4 | 2.3 | 25 | 1.2 | 1.9 | 1.8 | 2.3 |
| 4 | ...... | 1.4 | 1.7 | 3.6 | 15 | ...... | 1.6 | 1.4 | 2.3 | 26 | 1.3 | 2.8 | 1.8 | 3.6 |
| 5 | ...... | 1.4 | 1.7 | 3.2 | 16 | ...... | 2.5 | 1.4 | 2.2 | 27 | 1.5 | 2.4 | 2.8 | 4.1 |
| 6 | ...... | 1.9 | 1.7 | 3.1 | 17 | 1.3 | 2.1 | 1.4 | 2.3 | 28 | 1.9 | 2.2 | 2.5 | 3.9 |
| 7 | ...... | 3.1 | 1.6 | 3.2 | 18 | 1.3 | 2.6 | 1.7 | 2.4 | 29 | 1.7 | 1.9 | 2.4 | 3.4 |
| 8 | ...... | 2.8 | 1.6 | 3.5 | 19 | 1.3 | 2.5 | 1.9 | 2.5 | 30 | 1.6 | 1.9 | 3.1 | 3.5 |
| 9 | ...... | 2.2 | 1.6 | 3.1 | 20 | 1.3 | 2.1 | 3.0 | 2.9 | 31 | ...... | 1.8 | ...... | 4.1 |
| 10 | ...... | 1.9 | 1.5 | 2.9 | 21 | 1.3 | 2.0 | 2.3 | 2.8 | | | | | |
| 11 | ...... | 1.8 | 1.5 | 2.6 | 22 | 1.2 | 1.9 | 2.1 | 2.6 | | | | | |

## COAST FORK OF WILLAMETTE RIVER NEAR GOSHEN, OREG.

This station was established August 23, 1905, by L. R. Allen. It is located at the highway bridge 3 miles east of Goshen, Oreg., 9 miles southeast of Eugene, and about 4 miles above the junction of Coast and Middle forks of Willamette River.

The channel is straight for 500 feet above and 800 feet below the station. The water flows with an even current. Both banks are covered with undergrowth and liable to overflow during flood stages. The bed of the stream is of coarse gravel or small bowlders, is free from vegetation, and is liable to shift during high water. There is but one channel at all stages, broken by the piers of the bridge.

Discharge measurements are made from the downstream side of the highway bridge, 530 feet in length, including approaches. The initial point for soundings is two 6-penny nails driven into the first plank of the left approach of the bridge, downstream side. Low-water measurements are made by wading about 100 feet below the bridge.

The gage is in two sections. The lower section is a vertical staff fastened to an old pier in the center of the stream; the upper section is a vertical scale painted on the lower bridge caisson on the left bank. The total length of the gage is 18 feet. During 1905 the gage was read once each day by John D. West. The bench mark is the top of a large circular washer over the center of the bridge caisson on which the upper portion of the gage is painted; elevation, 26.25 feet above the datum of the gage.

*Discharge measurements of Coast Fork of Willamette River near Goshen, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 23 | L. R. Allen | 80 | 47 | 1.42 | 0.30 | 68 |
| November 7 | do | 165 | 204 | .89 | .67 | 182 |
| December 29 | do | 241 | 677 | 2.82 | 2.78 | 1,908 |

*Daily gage height, in feet, of Coast Fork of Willamette River near Goshen, Oreg., for 1905*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 0.25 | ....... | 1.0 | 2.9 | 17 | ....... | 0.25 | 1.5 | 0.4 | 1.5 |
| 2 | ....... | .25 | ....... | .9 | 3.0 | 18 | ....... | .25 | 1.3 | .6 | 1.5 |
| 3 | ....... | .25 | ....... | .8 | 3.1 | 19 | ....... | .25 | 1.3 | 1.0 | 1.9 |
| 4 | ....... | .25 | 0.5 | .6 | 3.3 | 20 | ....... | .25 | 1.1 | 2.3 | 3.1 |
| 5 | ....... | .25 | .5 | .6 | 2.8 | 21 | ....... | ....... | 1.0 | 1.9 | 3.0 |
| 6 | ....... | .25 | .5 | .5 | 2.5 | 22 | ....... | ....... | 1.0 | 1.5 | 2.5 |
| 7 | ....... | .25 | 1.4 | .5 | 2.7 | 23 | 0.3 | ....... | .9 | 1.3 | 2.0 |
| 8 | ....... | .2 | 2.3 | .5 | 3.2 | 24 | .3 | ....... | .8 | 1.3 | 1.9 |
| 9 | ....... | .2 | 1.5 | .4 | 2.6 | 25 | .3 | ....... | .9 | 1.2 | 1.7 |
| 10 | ....... | .2 | 1.01 | .4 | 2.2 | 26 | .3 | ....... | 2.0 | 1.0 | 2.2 |
| 11 | ....... | .2 | 1.0 | .4 | 2.0 | 27 | .3 | ....... | 1.7 | 2.2 | 3.7 |
| 12 | ....... | .2 | .8 | .4 | 2.0 | 28 | .3 | ....... | 1.5 | 2.3 | 3.3 |
| 13 | ....... | .25 | .7 | .4 | 1.9 | 29 | .25 | ....... | 1.3 | 1.9 | 2.8 |
| 14 | ....... | .25 | .6 | .3 | 1.5 | 30 | .25 | ....... | 1.2 | 3.0 | 3.0 |
| 15 | ....... | .25 | .7 | .3 | 1.3 | 31 | .25 | ....... | 1.0 | ....... | 5.0 |
| 16 | ....... | .25 | 1.9 | .3 | 1.5 | | | | | | |

## M'KENZIE RIVER AT HENDRICKS FERRY, OREG.

This station was established September 12, 1905, by L. R. Allen. It is located at Hendricks Ferry, 11 miles above Springfield, about 3 miles above the mouth of Camp Creek.

The channel is straight for 500 feet above and 800 feet below the station. The current is swift. The right bank is comparatively high, clean, and liable to overflow during extreme floods. The left bank is somewhat higher, covered with brush, and does not overflow. The bed of the stream is composed of coarse gravel or small bowlders and is free from vegetation and shifting. There is but one channel at all stages. The accuracy of measurements may be affected by floating logs during the running season.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point for soundings is a tin tag on the tagged wire 6 feet from the cable support on the left bank.

The gage is a vertical staff spiked to a willow tree about 250 feet above the cable, on the left bank. During 1905 the gage was read once each day by Grant Hendricks. The bench mark is the top of a three-fourths-inch bolt cemented in the rock about 30 feet below the gage rod, on the left bank; elevation, 14.22 feet above the datum of the gage and 571.61 feet above sea level, the latter elevation being obtained from a bench mark set by a professor and students of the University of Oregon.

*Discharge measurements of McKenzie River at Hendricks Ferry, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| September 12 | L. R. Allen | 395 | 928 | 1.69 | 1.30 | 1,571 |
| November 10 | do | 398 | 880 | 2.05 | 1.12 | 1,806 |
| December 30 | do | 404 | 1,369 | 3.58 | 2.65 | 4,897 |

*Daily gage height, in feet, of McKenzie River at Hendricks Ferry, Oreg., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.5 | 1.3 | 2.0 | 12 | 1.3 | 1.45 | 1.1 | 1.9 | 22 | 1.3 | 1.4 | 1.55 | 1.95 |
| 2 | ...... | 1.5 | 1.3 | 2.2 | 13 | 1.35 | 1.5 | 1.1 | 1.85 | 23 | 1.3 | 1.3 | 1.4 | 1.8 |
| 3 | ...... | 1.45 | 1.25 | 2.4 | 14 | 1.3 | 1.7 | 1.1 | 1.8 | 24 | 1.3 | 1.3 | 1.35 | 1.85 |
| 4 | ...... | 1.5 | 1.25 | 2.45 | 15 | 1.3 | 2.3 | 1.1 | 1.75 | 25 | 1.7 | 1.85 | 1.25 | 1.7 |
| 5 | ...... | 1.55 | 1.2 | 2.2 | 16 | 1.3 | 1.9 | 1.1 | 1.75 | 26 | 1.55 | 2.1 | 1.8 | 3.4 |
| 6 | ...... | 1.75 | 1.2 | 2.2 | 17 | 1.3 | 1.5 | 1.1 | 2.35 | 27 | 1.5 | 1.75 | 1.8 | 3.1 |
| 7 | ...... | 2.8 | 1.2 | 2.9 | 18 | 1.3 | 1.9 | 1.3 | 2.2 | 28 | 1.5 | 1.6 | 1.75 | 2.6 |
| 8 | ...... | 2.3 | 1.2 | 2.9 | 19 | 1.3 | 1.6 | 1.8 | 2.1 | 29 | 1.5 | 1.5 | 1.9 | 2.24 |
| 9 | ...... | 1.8 | 1.1 | 2.4 | 20 | 1.3 | 1.5 | 1.75 | 2.2 | 30 | 1.5 | 1.4 | 2.3 | 2.8 |
| 10 | ...... | 1.7 | 1.1 | 2.2 | 21 | 1.3 | 1.4 | 1.6 | 1.9 | 31 | ...... | 1.35 | ...... | 2.7 |
| 11 | ...... | 1.4 | 1.1 | 2.0 | | | | | | | | | | |

## WILLAMETTE RIVER AT ALBANY, OREG.

This station was established July 21, 1905, by L. R. Allen. It is located at the Corvallis and Eastern Railroad bridge at Albany, Oreg., just above the mouth of Calipooia Creek and 7 miles above the mouth of Santiam River.

The channel is slightly curved for about half a mile above and straight for half a mile below the station. The current is uniform and has a medium velocity. The right bank is high, composed of sand and fine gravel, covered with brush, and does not overflow. The left bank is low, composed of sand and gravel, covered with brush, and subject to overflow during high water. The bed of the stream is of sand and fine gravel, is free from vegetation, and is liable to shift during high water. There is one channel at low and two at high stages, broken by the piers of the bridge.

Discharge measurements are made from the upstream side of the railway bridge. The initial point for soundings is a large nail driven into the upstream guard rail over the center of the right-bank pier.

The gage is a vertical staff fastened to the lower end of the right-bank bridge pier. The gage reads to 36 feet. During 1905 the gage was read once each day by Fred Aldrich. The bench mark is the top of a railroad spike driven into a cross sill over the second pier from the right bank, downstream side; elevation, 48.05 feet above the datum of the gage.

July 20, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Area of section, 3,724 square feet; mean velocity, 0.92 foot per second; gage height, 3.29 feet; discharge, 3,433 second-feet.

*Daily gage height, in feet, of Willamette River at Albany, Oreg., for 1905.*

| Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. | Day. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.3 | 2.8 | 3.4 | 5.35 | 12 | 2.2 | 3.5 | 2.7 | 5.05 | 22 | 2.2 | 3.5 | 4.25 | 6.65 |
| 2 | 2.3 | 2.8 | 3.2 | 5.6 | 13 | 2.2 | 3.2 | 2.7 | 4.1 | 23 | 2.2 | 3.5 | 3.1 | 5.75 |
| 3 | 2.3 | 2.8 | 3.1 | 6.25 | 14 | 2.2 | 3.2 | 2.6 | 4.75 | 24 | 2.2 | 3.3 | 3.6 | 5.7 |
| 4 | 2.3 | 2.8 | 3.05 | 6.5 | 15 | 2.2 | 2.11 | 2.7 | 4.7 | 25 | 2.2 | 3.2 | 3.5 | 5.1 |
| 5 | 2.05 | 2.8 | 3.1 | 6.55 | 16 | 2.2 | 2.11 | 2.6 | 4.45 | 26 | 2.2 | 3.2 | 3.45 | 5.5 |
| 6 | 2.05 | 2.95 | 3.1 | 5.6 | 17 | 2.2 | 3.1 | 2.6 | 4.45 | 27 | 2.3 | 4.3 | 3.4 | 7.6 |
| 7 | 2.2 | 2.11 | 2.11 | 5.5 | 18 | 2.2 | 3.1 | 2.6 | 4.8 | 28 | 2.4 | 4.1 | 4.55 | 7.6 |
| 8 | 2.2 | 3.11 | 2.11 | 6.2 | 19 | 2.2 | 4.05 | 2.6 | 4.9 | 29 | 2.7 | 3.11 | 4.5 | 7.8 |
| 9 | 2.2 | 4.9 | 2.10 | 6.85 | 20 | 2.2 | 3.11 | 3.65 | 5.75 | 30 | 2.7 | 3.7 | 4.55 | 7.45 |
| 10 | 2.2 | 4.2 | 2.10 | 5.6 | 21 | 2.2 | 3.7 | 4.45 | 6.75 | 31 | ...... | 3.5 | ...... | 8.8 |
| 11 | 2.2 | 3.7 | 2.7 | 5.6 | | | | | | | | | | |

## SANTIAM RIVER AT JEFFERSON, OREG.

This station was established July 19, 1905, by L. R. Allen. It is located at the Southern Pacific Railroad bridge at Jefferson, Oreg., 2½ miles below the junction of North and South forks.

The channel is straight for 500 feet above and 700 feet below the station. The current is uniform and sluggish at low water. The right bank is comparatively high, clean at the station, and liable to overflow but little during extreme high water. The left bank is low, clean, and liable to overflow. The bed of the stream is composed of rock and coarse gravel, is free from vegetation, and is liable to shift during floods. There is but one channel at low water, broken by the piers of the bridge, but during floods water runs over the left bank and through a slough several hundred feet to the right of the main channel. The accuracy of measurements may be affected by rafts of logs at the mill near by during low water.

Discharge measurements are made from the upstream side of the Southern Pacific Railroad bridge. The initial point for soundings is on the upstream guard rail, near the end of the rail on the right-bank trestle.

The gage is a vertical staff fastened to the lower side of the bridge piers. During 1905 the gage was read once each day by C. Alsted. The bench mark is the top of four 30-penny nails driven into the cross sill over the center of the right-bank pier; elevation, 35.22 feet above the datum of the gage.

July 18, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Width, 326 feet; area of section, 2,659 square feet; mean velocity, 0.31 foot per second; gage height, 3.41 feet; discharge, 817 second-feet.

*Daily gage height, in feet, of Santiam River at Jefferson, Oreg., for 1905.*

| Day. | Oct. | Nov. | Dec. | Day. | Oct. | Nov. | Dec. | Day. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 4.5 | 6.15 | 12 | 5.0 | 3.8 | 5.8 | 22 | 4.65 | 5.0 | 6.0 |
| 2 | ...... | 4.4 | 6.85 | 13 | 4.8 | 3.7 | 5.5 | 23 | 4.5 | 4.7 | 5.8 |
| 3 | ...... | 4.3 | 6.95 | 14 | 4.6 | 3.7 | 5.4 | 24 | 4.5 | 4.5 | 5.5 |
| 4 | ...... | 4.2 | 6.9 | 15 | 4.8 | 3.6 | 5.2 | 25 | 4.8 | 4.4 | 5.4 |
| 5 | ...... | 4.15 | 6.5 | 16 | 5.9 | 3.6 | 5.2 | 26 | 6.5 | 4.5 | 7.6 |
| 6 | ...... | 4.1 | 6.5 | 17 | 5.4 | 3.6 | 6.2 | 27 | 5.8 | 5.6 | 7.4 |
| 7 | ...... | 4.0 | 6.9 | 18 | 5.7 | 3.9 | 6.6 | 28 | 5.4 | 5.3 | 6.8 |
| 8 | 7.5 | 4.0 | 7.4 | 19 | 5.4 | 4.5 | 6.5 | 29 | 5.0 | 5.3 | 6.5 |
| 9 | 6.6 | 3.9 | 6.8 | 20 | 5.0 | 6.1 | 6.8 | 30 | 4.8 | 6.0 | 6.8 |
| 10 | 5.95 | 3.9 | 6.2 | 21 | 4.8 | 5.35 | 6.5 | 31 | 4.6 | ...... | 6.95 |
| 11 | 5.4 | 3.8 | 6.0 | | | | | | | | |

## NORTH FORK OF SANTIAM RIVER NEAR MEHAMA, OREG.

This station was established July 11, 1905, by L. R. Allen. It is located just below the highway bridge at Mehama, Oreg., about 1½ miles north of Lyons, the nearest railroad station. The station is about 12 miles below the junction of Little North Fork and North Fork.

The channel is straight for about 600 feet above and 300 feet below the station. The current is swift and regular. The right bank is high, rocky, timbered, and does not overflow. The left bank is low, covered with some brush, and is subject to overflow during floods. The bed of the stream is of rock or coarse gravel, free from vegetation, and liable to shift slightly during floods.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is zero of the tagged wire, 25 feet from the cable support on the right bank.

The gage is a staff in two sections. The lower section is inclined. The upper section is vertical, being fastened at the lower end to the inclined section. During 1905 the gage was read once each day by F. U. Hull. The bench mark is the top of a 1-inch bolt cemented in soft sandstone near the gage rod; elevation, 12.60 feet above the datum of the gage.

*Discharge measurements of North Fork of Santiam River near Mehama, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| July 11 | L. R. Allen | 160 | 756 | 1.38 | 2.90 | 1,048 |
| October 18 | do | 202 | 1,013 | 3.51 | 4.44 | 3,556 |
| November 16 | J. H. Lewis | 155 | 756 | 1.29 | 2.90 | 973 |
| December 12 | L. R. Allen | 250 | 927 | 3.11 | 4.24 | 2,881 |

*Daily gage height, in feet, of North Fork of Santiam River near Mehama, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 2.65 | 2.5 | 3.35 | 3.55 | 4.3 | 17 | 2.8 | 2.6 | 2.6 | 4.4 | 2.9 | 5.75 |
| 2 | ...... | 2.65 | 2.5 | 3.55 | 3.4 | 5.0 | 18 | 2.8 | 2.6 | 2.55 | 4.45 | 3.35 | 5.4 |
| 3 | ...... | 2.65 | 2.5 | 3.4 | 3.4 | 5.3 | 19 | 2.75 | 2.6 | 2.55 | 4.15 | 4.8 | 5.4 |
| 4 | ...... | 2.65 | 2.5 | 6.8 | 3.4 | 5.1 | 20 | 2.75 | 2.55 | 2.55 | 3.95 | 4.6 | 5.05 |
| 5 | ...... | 2.65 | 2.5 | 5.1 | 3.4 | 5.0 | 21 | 2.75 | 2.55 | 2.55 | 3.8 | 4.0 | 4.75 |
| 6 | ...... | 2.65 | 2.5 | 5.35 | 3.25 | 5.1 | 22 | 2.75 | 2.55 | 2.55 | 3.7 | 3.8 | 4.45 |
| 7 | ...... | 2.65 | 2.5 | 6.6 | 3.2 | 5.5 | 23 | 2.75 | 2.55 | 2.5 | 3.6 | 3.7 | 4.3 |
| 8 | ...... | 2.65 | 2.45 | 5.9 | 3.15 | 5.6 | 24 | 2.7 | 2.55 | 2.5 | 3.65 | 3.55 | 4.1 |
| 9 | ...... | 2.6 | 2.45 | 5.2 | 3.1 | 5.0 | 25 | 2.7 | 2.5 | 4.35 | 5.1 | 3.5 | 4.0 |
| 10 | ...... | 2.6 | 2.45 | 4.7 | 3.1 | 4.7 | 26 | 2.7 | 2.5 | 4.35 | 5.2 | 4.4 | 5.9 |
| 11 | ...... | 2.6 | 2.45 | 4.3 | 3.1 | 4.4 | 27 | 2.7 | 2.5 | 3.25 | 4.6 | 4.2 | 5.25 |
| 12 | 2.9 | 2.6 | 2.55 | 4.1 | 3.0 | 4.3 | 28 | 2.7 | 2.55 | 3.35 | 4.25 | 4.0 | 4.9 |
| 13 | 2.9 | 2.6 | 2.8 | 3.9 | 3.0 | 4.15 | 29 | 2.7 | 2.55 | 3.35 | 4.0 | 4.1 | 4.55 |
| 14 | 2.8 | 2.6 | 2.7 | 3.7 | 2.95 | 4.1 | 30 | 2.65 | 2.55 | 3.5 | 3.85 | 4.55 | 4.7 |
| 15 | 2.8 | 2.6 | 2.55 | 4.9 | 2.9 | 4.1 | 31 | 2.65 | 2.5 | ...... | 3.65 | ...... | 4.6 |
| 16 | 2.8 | 2.5 | 2.5 | 4.6 | 2.9 | 4.1 | | | | | | | |

## SOUTH FORK OF SANTIAM RIVER AT WATERLOO, OREG.

This station was established July 28, 1905, by L. R. Allen. It is located about one-half mile below the highway bridge at Waterloo, Oreg. The station is about 4 miles above the mouth of Hamilton Creek, and about 3 miles above a dam which diverts water into a canal for the use of the town of Albany.

The channel is straight for 800 feet above and below the station. The current has a good uniform velocity. Both banks are fairly high and thickly covered with undergrowth, but are liable to overflow during extreme floods. The bed of the stream is of coarse gravel or small bowlders, is free from vegetation, and is liable to shift during floods. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point for soundings is a tin tag on the tagged wire, 2½ feet from the cable support at the right bank.

The gage is on the right bank about 100 feet below the cable. It is a staff in two sections, the lower inclined, the upper vertical. During 1905 the gage was read once each day by John B. Hudelson. Bench marks were established as follows: (1) The top of a three-fourths-inch bolt cemented in rock near the lower portion of the gage rod; elevation, 2.88

feet. (2) The top of five 30-penny nails driven into the root of a large fir tree about 300 feet below the cable on the right bank; elevation, 24.70 feet. Elevations refer to the datum of the gage.

July 28, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Width, 150 feet; area of section, 246 square feet; mean velocity, 1.52 feet per second; gage height, 1.06 feet; discharge, 375 second-feet.

*Daily gage height, in feet, of South Fork of Santiam River at Waterloo, Oreg., for 1905.*

| Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 1.05 | 0.8 | 1.9 | 2.1 | 3.4 | 17 | ...... | 1.0 | .9 | 2.9 | 1.4 | 4.0 |
| 2 | ...... | 1.0 | .8 | 1.5 | 2.0 | 3.9 | 18 | ...... | 1.0 | .9 | 3.3 | 1.8 | 3.7 |
| 3 | ...... | 1.0 | .8 | 1.6 | 2.2 | 4.2 | 19 | ...... | 1.0 | .9 | 2.4 | 2.0 | 3.8 |
| 4 | ...... | 1.0 | .7 | 4.5 | 1.9 | 4.2 | 20 | ...... | 1.0 | .9 | 2.5 | 3.2 | 4.0 |
| 5 | ...... | 1.0 | .7 | 3.0 | 1.9 | 3.2 | 21 | ...... | 1.0 | .8 | 2.3 | 2.2 | 3.6 |
| 6 | ...... | 1.0 | .7 | 3.1 | 1.9 | 3.9 | 22 | ...... | .9 | .8 | 2.2 | 2.3 | 3.3 |
| 7 | ...... | 1.0 | .7 | 3.5 | 1.7 | 4.5 | 23 | ...... | .9 | .8 | 2.2 | 2.1 | 3.1 |
| 8 | ...... | 1.0 | .6 | 4.4 | 1.6 | 4.9 | 24 | ...... | .9 | .8 | 2.0 | 2.0 | 2.7 |
| 9 | ...... | 1.0 | .6 | 3.6 | 1.6 | 4.9 | 25 | ...... | .9 | .8 | 2.3 | 1.9 | 2.7 |
| 10 | ...... | 1.0 | .6 | 3.0 | 1.5 | 4.5 | 26 | ...... | .8 | 1.0 | 3.9 | 2.0 | 3.5 |
| 11 | ...... | 1.0 | .6 | 2.6 | 1.5 | 3.2 | 27 | ...... | .8 | 1.9 | 2.8 | 3.1 | 4.4 |
| 12 | ...... | 1.0 | .7 | 2.3 | 1.5 | 3.0 | 28 | ...... | .8 | 1.8 | 2.3 | 2.8 | 4.2 |
| 13 | ...... | 1.0 | .7 | 2.2 | 1.4 | 3.0 | 29 | 1.05 | .8 | 1.8 | 2.5 | 2.6 | 3.7 |
| 14 | ...... | 1.0 | .9 | 2.0 | 1.4 | 2.7 | 30 | 1.05 | .8 | 1.5 | 2.3 | 3.4 | 4.0 |
| 15 | ...... | 1.0 | .8 | 2.4 | 1.4 | 2.7 | 31 | 1.05 | .8 | ...... | 2.3 | ...... | 4.2 |
| 16 | ...... | 1.0 | .8 | 3.9 | 1.4 | 2.7 | | | | | | | |

## LUCKIAMUTE RIVER NEAR SUVER, OREG.

This station was established August 18, 1905, by L. R. Allen. It is located just below Helmick bridge on the public highway, 4 miles northwest of Suver, Oreg., 2 miles west of Parkers Station, and about 3 miles below the junction of the main forks of the river.

The channel is straight for 300 feet above and below the station. The current is regular. Both banks are high, covered with brush, and liable to overflow during extreme floods. The bed of the stream is of sand, is free from vegetation, and shifts during floods. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay line. The initial point for soundings is a tag on the tagged line 7.2 feet from the cable support on the right bank.

The gage is on the left bank at the bridge. It is in two sections, the lower inclined, the upper vertical, both being secured to posts supporting the bridge. The gage rod reads to 32.8 feet. During 1905 the gage was read once each day by Maggie J. Evans. The bench mark is the top of three 30-penny nails driven into the cross sill of the bridge, downstream side, 5 feet from the end of the first panel from the left bank; elevation, 39.86 feet above the datum of the gage.

*Discharge measurements of Luckiamute River near Suver, Oreg., in 1905.*

| Date. | Hydrographer. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|
| | | *Feet.* | *Square feet.* | *Feet per second.* | *Feet.* | *Second-feet.* |
| August 18 | L. R. Allen | 45 | 121 | 0.60 | 1.47 | 73 |
| October 7 | do | 79 | 571 | 2.07 | 8.57 | 1,182 |

*Daily gage height, in feet, of Luckiamute River near Suver, Oreg., for 1905.*

| Day. | Aug. | Sept. | Oct. | Nov. | Dec. | Day. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ....... | 0.95 | 2.5 | 2.8 | 6.6 | 17 | ....... | 1.3 | 3.5 | 2.0 | 8.4 |
| 2 | ....... | .9 | 2.2 | 2.55 | 7.3 | 18 | ....... | 1.1 | 3.5 | 2.1 | 12.0 |
| 3 | ....... | .95 | 2.5 | 2.75 | 7.55 | 19 | ....... | 1.25 | 3.4 | 3.0 | 10.7 |
| 4 | ....... | 1.2 | 9.0 | 2.45 | 7.15 | 20 | 1.25 | 1.5 | 3.3 | 7.75 | 14.35 |
| 5 | ....... | 1.0 | 6.2 | 2.6 | 6.45 | 21 | 1.2 | 1.2 | 3.0 | 5.5 | 13.15 |
| 6 | ....... | 1.5 | 7.1 | 2.4 | 7.25 | 22 | 1.25 | 1.1 | 3.0 | 4.5 | 11.4 |
| 7 | ....... | 1.5 | 7.5 | 2.2 | 7.30 | 23 | 1.5 | 1.1 | 2.85 | 4.15 | 9.75 |
| 8 | ....... | .95 | 7.7 | 2.3 | 7.0 | 24 | 1.1 | 1.1 | 2.8 | 3.75 | 9.2 |
| 9 | ....... | .95 | 6.65 | 2.05 | 6.25 | 25 | .95 | 1.15 | 2.95 | 3.5 | 8.3 |
| 10 | ....... | 1.0 | 6.35 | 2.15 | 6.0 | 26 | 1.0 | 1.8 | 3.65 | 3.2 | 15.4 |
| 11 | ....... | 1.0 | 4.55 | 2.15 | 5.8 | 27 | .95 | 3.2 | 3.1 | 3.7 | 15.2 |
| 12 | ....... | 1.0 | 4.5 | 2.1 | 5.1 | 28 | 1.5 | 3.5 | 3.35 | 3.5 | 13.0 |
| 13 | ....... | 1.1 | 3.6 | 2.0 | 5.1 | 29 | 1.1 | 2.75 | 2.8 | 3.6 | 12.2 |
| 14 | ....... | 1.1 | 3.3 | 2.05 | 4.8 | 30 | 1.4 | 2.6 | 2.8 | 5.55 | 12.4 |
| 15 | ....... | 1.5 | 3.3 | 2.0 | 4.35 | 31 | 1.0 | ....... | 2.7 | ....... | 18.65 |
| 16 | ....... | 1.0 | 4.15 | 2.0 | 4.2 | | | | | | |

## MOLALLA RIVER AT DICKEY PRAIRIE, OREG.

This station was established November 1, 1905, by L. R. Allen. It is located at Dickey Prairie, 3 miles below the junction of the forks of the river, 3½ miles southeast of Molalla, Oreg.

The channel is straight for 400 feet above and below the station. The current is swift and somewhat rough. The right bank is low, wooded, and subject to overflow. The left bank is fairly high, covered with brush, and not liable to overflow. The bed of the stream is of coarse gravel or small bowlders, free from vegetation, and shifting. There is but one channel during low and ordinary stages, but during extreme high water there is a slough on the right bank, which will have to be measured by wading.

Discharge measurements are made by means of a cable, car, tagged line, and stay wire. The initial point for soundings is a tin tag on the tagged wire 7 feet from the cable support on the right bank.

The gage is a staff in two sections on the left bank, about 200 feet above the cable. The lower section is inclined and fastened to the rock. The upper section is vertical and fastened to an alder tree. The total height of the gage is 14.00 feet. It is read once each day by Raymond Dickey. The bench mark is the top of three 30-penny nails driven into a bench made on the root of a fir tree about 20 feet south and 30 feet west of the gage; elevation, 14.85 feet above the datum of the gage.

November 2, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Width, 106 feet; area of section, 226 square feet; mean velocity, 1.68 feet per second; gage height, 1.83 feet; discharge, 376 second-feet.

*Daily gage height, in feet, of Molalla River at Dickey Prairie, Oreg., for 1905.*

| Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.85 | 2.8 | 9 | 1.45 | 3.2 | 17 | 1.25 | 3.8 | 25 | 1.85 | 2.4 |
| 2 | 1.8 | 4.5 | 10 | 1.4 | 2.9 | 18 | 1.6 | 3.5 | 26 | 2.9 | 3.7 |
| 3 | 1.75 | 4.0 | 11 | 1.4 | 2.7 | 19 | 3.7 | 3.4 | 27 | 2.55 | 3.4 |
| 4 | 1.75 | 3.6 | 12 | 1.35 | 2.55 | 20 | 2.9 | 3.2 | 28 | 2.4 | 3.1 |
| 5 | 1.7 | 3.8 | 13 | 1.35 | 2.45 | 21 | 2.5 | 3.1 | 29 | 2.6 | 2.8 |
| 6 | 1.6 | 3.8 | 14 | 1.3 | 2.3 | 22 | 2.25 | 2.85 | 30 | 2.9 | 3.2 |
| 7 | 1.55 | 3.85 | 15 | 1.3 | 2.25 | 23 | 2.05 | 2.7 | 31 | ....... | 3.0 |
| 8 | 1.5 | 3.5 | 16 | 1.25 | 2.45 | 24 | 1.9 | 2.45 | | | |

## CLACKAMAS RIVER NEAR BARTON, OREG.

This station was established October 2, 1905, by L. R. Allen. It is located 2½ miles below Barton, Oreg., 1½ miles below the mouth of Deep Creek.

The channel is straight for 500 feet above and 600 feet below the station. The current is swift. The right bank is comparatively high, clean, and liable to overflow during extreme floods. The left bank is high, covered with brush, and does not overflow. The bed of the stream is of coarse gravel or small bowlders, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the tin tag on the tagged wire 1.7 feet from the cable support on the right bank.

The gage is a staff in two sections, on the right bank at the cable. The lower section is inclined, the upper section is vertical. During 1905 the gage was read once each day by Le Roy Breithaupt. Bench marks were established as follows: (1) The top of three 30-penny nails driven into the sill at the northwest corner of an old barn southeast of the gage; elevation, 19.21 feet. (2) The top of the head of a bolt driven into a large alder tree by the upright portion of the gage; elevation, 16.09 feet. Elevations refer to the datum of the gage.

October 2, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Width, 310 feet; area of section, 704 square feet; mean velocity, 2.27 feet per second; gage height, 3.30 feet; discharge, 1,598 second-feet.

*Daily gage height, in feet, of Clackamas River near Barton, Oreg., for 1905.*

| Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 4.23 | 9 | | 4.8 | 17 | 2.9 | 4.6 | 25 | 3.55 | 4.0 |
| 2 | | 5.47 | 10 | | 4.5 | 18 | 3.1 | 5.3 | 26 | 3.8 | 5.1 |
| 3 | | 5.3 | 11 | | 4.3 | 19 | 3.62 | 5.25 | 27 | 4.33 | 5.05 |
| 4 | | 5.1 | 12 | 3.0 | 4.12 | 20 | 4.7 | 5.2 | 28 | 4.1 | 4.75 |
| 5 | | 4.8 | 13 | 3.0 | 4.0 | 21 | 4.1 | 4.8 | 29 | 4.1 | 4.55 |
| 6 | | 4.8 | 14 | 3.0 | 3.9 | 22 | 3.82 | 4.6 | 30 | 4.19 | 4.5 |
| 7 | | 4.9 | 15 | 3.0 | 3.8 | 23 | 3.7 | 4.33 | 31 | | 4.8 |
| 8 | | 5.13 | 16 | 3.0 | 3.8 | 24 | 3.5 | 4.1 | | | |

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in the Columbia River drainage basin in Oregon in 1905:

*Miscellaneous discharge measurements made in Columbia River drainage basin in Oregon in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Ft. per second* | *Feet.* | *Sec.-feet.* |
| January 8 | Bear Creek | Wallowa | 29.2 | 33.5 | 2.54 | | 75.2 |
| March 31 | do | do | 30.5 | 34.6 | 1.56 | | 54.5 |
| May 19 | do | do | 35.5 | 66.8 | 4.56 | | 305 |
| September 18 | do | do | | | | | .5 |
| November 29 | do | do | 19.3 | 14.9 | .81 | | 12.1 |
| November 5 | Birch Creek | Pendleton | 11.3 | 4.4 | .77 | | 3.4 |
| December 23 | do | do | 14.5 | 10.1 | 2.40 | | 24.2 |
| March 3 | Burnt River | Huntington | 42.8 | 53.2 | 3.69 | | 196 |
| March 24 | do | do | 43.5 | 96.5 | 4.07 | | 393 |
| September 14 | do.[a] | do | | | | | |

[a] Dry for about two months.

*Miscellaneous discharge measurements made in Columbia River drainage basin in Oregon in 1905*—Continued.

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Ft. per second.* | *Feet.* | *Sec.-feet.* |
| November 22 | Burnt River | Huntington | 27 | 17.4 | 1.94 | | 33.9 |
| June 10 | Canyon Creek | Canyon City | 26 | 18.8 | 2.63 | | 49.4 |
| August 3 | Crescent Creek | Outlet Crescent Lake | 26 | 29 | 2.96 | | 85.8 |
| April 15 | Crooked River | NE. ¼ SW. ¼ sec. 5, T. 17 S., R. 17 E., Willamette meridian. | 83 | 287 | 2.19 | | 628 |
| April 18 | do | Forest | 90 | 301 | 2.45 | | 737 |
| May 19 | do | do | 85 | 162 | 1.67 | | 270 |
| June 10 | do | do | 24 | 23 | 1.35 | | 54 |
| August 11 | do | Prineville | 17 | 5.6 | 1.67 | | 9.4 |
| November 10 | do | do | 26 | 16.5 | 3.09 | | 51 |
| December 3 | do | Forest | 55 | 75 | 1.05 | | 79 |
| March 4 | Deschutes River | B. West's farm | 107 | 658 | 3.16 | | 2,080 |
| May 26 | do | Royce's ranch | 22.5 | 27 | 2.98 | | 80.4 |
| May 28 | do | Black Rock Ford | 73 | 81.9 | 2.40 | | 197 |
| June 27 | do | Royce's ranch | 23 | 21.5 | 2.13 | | 45.8 |
| Do | do | Black Rock Ford | 73 | 80.4 | 1.92 | | 154 |
| August 3 | do | Royce's ranch | 20 | 12.1 | 1.28 | | 15.4 |
| October 28 | do | SW. ¼ SW. ¼ sec. 31, T. 19, R. 11 E. | 106 | 584 | 2.59 | | 1,501 |
| November 17 | do | B. West's farm | 106 | 574 | 2.63 | | 1,460 |
| December 10 | do | do | 106 | 575 | 2.39 | | 1,375 |
| April 26 | East Fork of Deschutes River. | ½ mile below gaging station at Odell. | 44 | 34.8 | 1.78 | | 68.4 |
| April 29 | do | do | 43 | 36.8 | 1.78 | | 65.7 |
| June 25 | do | do | 43 | 33 | 1.51 | | 50 |
| Do | do | do | 43 | 33 | 1.33 | | 44 |
| March 5 | Deschutes Irrigation and Power Company's flume. | Near Bend | 5.3 | 5 | 4.50 | | 22.5 |
| June 10 | John Day River | John Day City | 30 | 81.4 | 3.30 | | 269 |
| September | McKay Creek | Pendleton | | | | | Dry. |
| November 16 | do | do | 14.2 | 5.8 | .71 | | 4.1 |
| December 23 | do | do | 38 | 85.7 | 1.02 | | 87.1 |
| September 20 | Minam River | At mouth near Elgin | 62.5 | 56.7 | 1.09 | | 61.9 |
| April 16 | Ochoco River | Prineville | 21 | 21.4 | 2.44 | | 52.2 |
| May 18 | do | do | 37 | 28.7 | 1.74 | | 50 |
| December 3 | do | do | 12 | 5.5 | .76 | | 4.2 |
| May 28 | Odell Lake Outlet | Odell Lake | 45 | 54.5 | 2.18 | | 119 |
| June 26 | do | do | 45 | 49.4 | 1.84 | | 90.8 |
| August 3 | do | do | 38 | 22.7 | 1.88 | | 42.6 |
| September 12 | Owyhee River | Wilson's ranch, Owyhee | 20 | 4.6 | 1.04 | | 4.8 |
| October 13 | do | do | 29.5 | 12.5 | 1.10 | | 13.7 |
| March 8 | Pauline Creek | Rosland | 8 | 5.5 | 2.22 | | 12.1 |
| May 24 | do | do | 7 | 4.9 | 1.62 | | 8 |
| June 24 | do | do | 7 | 3.4 | 1.12 | | 3.8 |
| October 25 | Quigley Creek | 3 miles from Hailey, Idaho. | 4.9 | 1.72 | 1.69 | | 2.91 |
| October 12 | Sandy | Salmon River post-office | 92.5 | 322 | 4.35 | 1.82 | 1,400 |
| March 17 | Satas | Alfalfa | 38 | 103 | 1.91 | | 197 |
| April 2 | do | do | 64 | 100 | 2.25 | 1.52 | 225 |
| October 3 | Silver Creek | Thompson's Valley | 12.5 | 8.4 | 1.31 | | 11 |
| December 4 | Squaw Creek | Sisters, above diversions | 30 | 29 | 1.67 | | 49 |
| December 5 | do | do | 31 | 30 | 1.69 | | 50 |

## CLACKAMAS RIVER NEAR BARTON, OREG.

This station was established October 2, 1905, by L. R. Allen. It is located 2½ miles below Barton, Oreg., 1½ miles below the mouth of Deep Creek.

The channel is straight for 500 feet above and 600 feet below the station. The current is swift. The right bank is comparatively high, clean, and liable to overflow during extreme floods. The left bank is high, covered with brush, and does not overflow. The bed of the stream is of coarse gravel or small bowlders, free from vegetation, and shifting. There is but one channel at all stages.

Discharge measurements are made by means of a cable, car, tagged wire, and stay wire. The initial point for soundings is the tin tag on the tagged wire 1.7 feet from the cable support on the right bank.

The gage is a staff in two sections, on the right bank at the cable. The lower section is inclined, the upper section is vertical. During 1905 the gage was read once each day by Le Roy Breithaupt. Bench marks were established as follows: (1) The top of three 30-penny nails driven into the sill at the northwest corner of an old barn southeast of the gage; elevation, 19.21 feet. (2) The top of the head of a bolt driven into a large alder tree by the upright portion of the gage; elevation, 16.09 feet. Elevations refer to the datum of the gage.

October 2, 1905, a discharge measurement made at this station by L. R. Allen gave the following results: Width, 310 feet; area of section, 704 square feet; mean velocity, 2.27 feet per second; gage height, 3.30 feet; discharge, 1,598 second-feet.

*Daily gage height, in feet, of Clackamas River near Barton, Oreg., for 1905.*

| Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. | Day. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ...... | 4.23 | 9 | ...... | 4.8 | 17 | 2.9 | 4.6 | 25 | 3.55 | 4.0 |
| 2 | ...... | 5.47 | 10 | ...... | 4.5 | 18 | 3.1 | 5.3 | 26 | 3.8 | 5.1 |
| 3 | ...... | 5.3 | 11 | ...... | 4.3 | 19 | 3.62 | 5.25 | 27 | 4.33 | 5.05 |
| 4 | ...... | 5.1 | 12 | 3.0 | 4.12 | 20 | 4.7 | 5.2 | 28 | 4.1 | 4.75 |
| 5 | ...... | 4.8 | 13 | 3.0 | 4.0 | 21 | 4.1 | 4.8 | 29 | 4.1 | 4.55 |
| 6 | ...... | 4.8 | 14 | 3.0 | 3.9 | 22 | 3.82 | 4.6 | 30 | 4.19 | 4.5 |
| 7 | ...... | 4.9 | 15 | 3.0 | 3.8 | 23 | 3.7 | 4.33 | 31 | ...... | 4.8 |
| 8 | ...... | 5.13 | 16 | 3.0 | 3.8 | 24 | 3.5 | 4.1 | | | |

## MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in the Columbia River drainage basin in Oregon in 1905:

*Miscellaneous discharge measurements made in Columbia River drainage basin in Oregon in 1905.*

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Ft. per second* | *Feet.* | *Sec.-feet.* |
| January 8 | Bear Creek | Wallowa | 29.2 | 33.5 | 2.54 | ...... | 75.2 |
| March 31 | do | do | 30.5 | 34.6 | 1.56 | ...... | 54.5 |
| May 19 | do | do | 35.5 | 66.8 | 4.56 | ...... | 305 |
| September 18 | do | do | ...... | ...... | ...... | ...... | .5 |
| November 29 | do | do | 19.3 | 14.9 | .81 | ...... | 12.1 |
| November 5 | Birch Creek | Pendleton | 11.3 | 4.4 | .77 | ...... | 3.4 |
| December 23 | do | do | 14.5 | 10.1 | 2.40 | ...... | 24.2 |
| March 3 | Burnt River | Huntington | 42.8 | 53.2 | 3.69 | ...... | 196 |
| March 24 | do | do | 43.5 | 96.5 | 4.07 | ...... | 393 |
| September 14 | do.[a] | do | ...... | ...... | ...... | ...... | ...... |

[a] Dry for about two months.

*Miscellaneous discharge measurements made in Columbia River drainage basin in Oregon in 1905*—Continued.

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Ft. per second.* | *Feet.* | *Sec.-feet.* |
| November 22 | Burnt River | Huntington | 27 | 17.4 | 1.94 | ....... | 33.9 |
| June 10 | Canyon Creek | Canyon City | 26 | 18.8 | 2.63 | ....... | 49.4 |
| August 3 | Crescent Creek | Outlet Crescent Lake | 26 | 29 | 2.96 | ....... | 85.8 |
| April 15 | Crooked River | NE. ¼ SW. ¼ sec. 5, T. 17 S., R. 17 E., Willamette meridian. | 83 | 287 | 2.19 | ....... | 628 |
| April 18 | do | Forest | 90 | 301 | 2.45 | ....... | 737 |
| May 19 | do | do | 85 | 162 | 1.67 | ....... | 270 |
| June 10 | do | do | 24 | 23 | 1.35 | ....... | 54 |
| August 11 | do | Prineville | 17 | 5.6 | 1.67 | ....... | 9.4 |
| November 10 | do | do | 26 | 16.5 | 3.09 | ....... | 51 |
| December 3 | do | Forest | 55 | 75 | 1.05 | ....... | 79 |
| March 4 | Deschutes River | B. West's farm | 107 | 658 | 3.16 | ....... | 2,080 |
| May 26 | do | Royce's ranch | 22.5 | 27 | 2.98 | ....... | 80.4 |
| May 28 | do | Black Rock Ford | 73 | 81.9 | 2.40 | ....... | 197 |
| June 27 | do | Royce's ranch | 23 | 21.5 | 2.13 | ....... | 45.8 |
| Do | do | Black Rock Ford | 73 | 80.4 | 1.92 | ....... | 154 |
| August 3 | do | Royce's ranch | 20 | 12.1 | 1.28 | ....... | 15.4 |
| October 28 | do | SW. ¼ SW. ¼ sec. 31, T. 19, R. 11 E. | 106 | 584 | 2.59 | ....... | 1,501 |
| November 17 | do | B. West's farm | 106 | 574 | 2.63 | ....... | 1,460 |
| December 10 | do | do | 106 | 575 | 2.39 | ....... | 1,375 |
| April 26 | East Fork of Deschutes River. | ½ mile below gaging station at Odell. | 44 | 34.8 | 1.78 | ....... | 68.4 |
| April 29 | do | do | 43 | 36.8 | 1.78 | ....... | 65.7 |
| June 25 | do | do | 43 | 33 | 1.51 | ....... | 50 |
| Do | do | do | 43 | 33 | 1.33 | ....... | 44 |
| March 5 | Deschutes Irrigation and Power Company's flume. | Near Bend | 5.3 | 5 | 4.50 | ....... | 22.5 |
| June 10 | John Day River | John Day City | 30 | 81.4 | 3.30 | ....... | 269 |
| September | McKay Creek | Pendleton | ....... | ....... | ....... | ....... | Dry. |
| November 16 | do | do | 14.2 | 5.8 | .71 | ....... | 4.1 |
| December 23 | do | do | 38 | 85.7 | 1.02 | ....... | 87.1 |
| September 20 | Minam River | At mouth near Elgin | 62.5 | 56.7 | 1.09 | ....... | 61.9 |
| April 16 | Ochoco River | Prineville | 21 | 21.4 | 2.44 | ....... | 52.2 |
| May 18 | do | do | 37 | 28.7 | 1.74 | ....... | 50 |
| December 3 | do | do | 12 | 5.5 | .76 | ....... | 4.2 |
| May 28 | Odell Lake Outlet | Odell Lake | 45 | 54.5 | 2.18 | ....... | 119 |
| June 26 | do | do | 45 | 49.4 | 1.84 | ....... | 90.8 |
| August 3 | do | do | 38 | 22.7 | 1.88 | ....... | 42.6 |
| September 12 | Owyhee River | Wilson's ranch, Owyhee | 20 | 4.6 | 1.04 | ....... | 4.8 |
| October 13 | do | do | 29.5 | 12.5 | 1.10 | ....... | 13.7 |
| March 8 | Pauline Creek | Rosland | 8 | 5.5 | 2.22 | ....... | 12.1 |
| May 24 | do | do | 7 | 4.9 | 1.62 | ....... | 8 |
| June 24 | do | do | 7 | 3.4 | 1.12 | ....... | 3.8 |
| October 25 | Quigley Creek | 3 miles from Hailey, Idaho. | 4.9 | 1.72 | 1.69 | ....... | 2.91 |
| October 12 | Sandy | Salmon River post-office | 92.5 | 322 | 4.35 | 1.82 | 1,400 |
| March 17 | Satas | Alfalfa | 38 | 103 | 1.91 | ....... | 197 |
| April 2 | do | do | 64 | 100 | 2.25 | 1.52 | 225 |
| October 3 | Silver Creek | Thompson's Valley | 12.5 | 8.4 | 1.31 | ....... | 11 |
| December 4 | Squaw Creek | Sisters, above diversions | 30 | 29 | 1.67 | ....... | 49 |
| December 5 | do | do | 31 | 30 | 1.69 | ....... | 50 |

*Miscellaneous discharge measurements made in Columbia River drainage basin in Oregon in 1905*—Continued.

| Date. | Stream. | Locality. | Width. | Area of section. | Mean velocity. | Gage height. | Discharge. |
|---|---|---|---|---|---|---|---|
| | | | *Feet.* | *Square feet.* | *Ft. per second.* | *Feet.* | *Sec.-feet.* |
| February 8 | Tumallo Creek | Bend | 26 | 37.6 | 3.17 | ....... | 120 |
| March 6 | .....do | .....do | 26 | 36.9 | 3.17 | ....... | 117 |
| June 21 | .....do | .....do | 25 | 39 | 3.44 | ....... | 134 |
| August 10 | .....do | .....do | 18 | 8.9 | 1.18 | ....... | 10.6 |
| November 26 | .....do | .....do | 24 | 32 | 3.00 | ....... | 97 |
| December 6 | .....do | .....do | 25 | 33 | 2.11 | ....... | 70 |
| September 28 | Umatilla River | Fosters | 62 | 45.7 | .42 | ....... | 19 |
| October 2 | .....do | .....do | 62 | 50.2 | .65 | 1.00 | 32.6 |
| October 5 | .....do | .....do | 61.8 | 44.8 | .42 | .87 | 18.5 |
| October 10 | .....do | .....do | 66 | 55.2 | .78 | 1.09 | 43 |
| October 18 | .....do | .....do | 69.4 | 60.5 | .95 | 1.17 | 57.6 |
| October 24 | .....do | .....do | 69 | 60.3 | .83 | 1.15 | 50.1 |
| October 26 | .....do | .....do | 70 | 63.9 | .93 | 1.18 | 59.7 |
| October 31 | .....do | .....do | 71.5 | 65.4 | 1.05 | 1.22 | 68.5 |
| August 9 | .....do | Below Echo, in sec. 16, T. 4, R. 28 E. | 19.5 | 22.6 | .73 | ....... | 16.5 |
| September 30 | .....do | .....do | 17.3 | 22.1 | .82 | ....... | 18.1 |
| September 19 | Wallowa River | Wallowa Falls above Wallowa Lake. | 21 | 21 | 1.57 | ....... | 33 |
| November 16 | Wild Horse Creek | Rug's ranch, Pendleton | 3.2 | .9 | .51 | ....... | .46 |
| December 23 | .....do | .....do | 3 | .96 | 1.77 | ....... | 1.7 |
| December 14 | South Fork of Yamhill River. | Sheridan | 122 | 428 | 1.36 | ....... | 583 |

## PUGET SOUND DRAINAGE BASIN.

For convenience in arrangement, the smaller rivers which have their headwaters on the western slope of the Cascade Range and which flow into Puget Sound north of Seattle have been grouped as the Puget Sound drainage.

## WHITE RIVER DRAINAGE BASIN.

White River has its source near Mount Rainier and flows into Puget Sound near Seattle, Wash. Cedar River is a tributary of White River.

### CEDAR RIVER NEAR RAVENSDALE, WASH.

This station was established September 27, 1902, by T. A. Noble. It is located at the intake of the Seattle waterworks and is 15 miles below Cedar Lake, 4 miles from the Northern Pacific Railway at Ravensdale, and 6 miles from the Columbia and Puget Sound Railway at Maple Valley.

The channel is straight. The right bank is steep; the left bank has a sloping gravelly beach. The bed is permanent, rocky near the right bank, and of sand and gravel near the left bank.

Gagings at this station are made at two points. The first is 142 feet below the dam, where the cross section is small, the current rapid, and conditions suitable for gaging at stages below 1 foot on the gage. The measurements at this point are made from a cable. The initial point for soundings is on the right bank. To the discharge measurements made below the dam should be added the amount of water flowing into the gravity system which supplies the city of Seattle. This varies from 34 to 37 second-feet. The discharge of this pipe line was measured during the winter of 1901-2 by T. A. Noble, and the results have been published in volume 49, page 112, Transactions of the American Society of Civil Engineers.

At all stages of the river above 1 foot on the gage the measurements are made from a cable located 600 feet above the dam, at a point where the cross section is large and suitable for gaging the higher stages of the river. The initial point for soundings is a spike driven into the top of a hemlock stump about 12 inches in diameter near the edge of the water.

The gage is a plain staff, to which is attached a hook gage and vernier reading to thousandths. When this gage is at zero the hook is level with the crest of the dam. It is fastened securely to the head-gates above the dam, and during 1905 was read daily by George Landsburg. The bench mark is the crest of the dam. The elevation, from city levels, of the south end is 535.831 feet and of the north end 535.840 feet.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

**Description:** 100, pp 463-464; 135, pp 276-277.
**Discharge:** 100, p 464; 135, p 277.
**Discharge, monthly:** 100, p 465; 135, p 278.
**Gage heights:** 100, p 464; 135, p 277.
**Rating table:** 100, p 465; 135, p 278.

*Daily gage height, in feet, of Cedar River near Ravensdale, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.53 | 1.30 | 0.93 | 1.27 | 1.04 | 1.72 | 1.01 | 0.67 | 0.58 | 0.50 | 1.06 | 1.20 |
| 2 | 1.64 | 1.19 | 1.41 | 1.22 | 1.07 | 1.64 | .98 | .67 | .58 | .71 | .98 | 1.32 |
| 3 | 1.71 | 1.72 | 1.76 | 1.17 | 1.06 | 1.70 | .96 | .67 | .57 | 1.53 | .97 | 1.36 |
| 4 | 1.72 | 1.58 | 1.79 | 1.07 | 1.02 | 1.93 | .93 | .67 | .57 | 1.49 | .98 | 1.38 |
| 5 | 1.64 | 1.51 | 1.73 | 1.05 | .99 | 1.81 | .91 | .66 | .56 | 1.70 | .94 | 1.40 |
| 6 | 1.50 | 1.48 | 1.63 | 1.06 | .98 | 1.71 | .88 | .65 | .56 | 1.88 | .90 | 1.38 |
| 7 | 1.35 | 1.47 | 1.51 | 1.09 | 1.02 | 1.69 | .86 | .65 | .54 | 1.78 | .90 | 1.43 |
| 8 | 1.30 | 1.43 | 1.47 | 1.09 | .91 | 1.58 | .85 | .64 | .55 | 1.98 | .87 | 1.44 |
| 9 | 1.21 | 1.40 | 1.44 | 1.08 | 1.25 | 1.51 | .81 | .65 | .54 | 1.82 | .83 | 1.40 |
| 10 | 1.14 | 1.38 | 1.48 | 1.06 | 1.14 | 1.45 | .78 | .64 | .54 | 1.69 | .78 | 1.36 |
| 11 | 1.08 | 1.32 | 1.47 | 1.08 | 1.11 | 1.36 | .77 | .64 | .54 | 1.50 | .76 | 1.28 |
| 12 | 1.04 | 1.28 | 1.48 | 1.05 | 1.06 | 1.31 | .77 | .63 | .54 | 1.39 | .76 | 1.24 |
| 13 | .96 | 1.25 | 1.38 | 1.04 | 1.15 | 1.18 | .76 | .61 | .59 | 1.35 | .74 | 1.17 |
| 14 | .99 | 1.18 | 1.27 | 1.08 | 1.29 | 1.12 | .84 | .62 | .58 | 1.27 | .72 | 1.14 |
| 15 | .95 | .97 | 1.17 | 1.06 | 1.46 | 1.09 | .77 | .60 | .57 | 1.32 | .72 | 1.12 |
| 16 | .92 | .73 | 1.08 | 1.05 | 1.47 | 1.05 | .77 | .61 | .57 | 1.26 | .72 | 1.09 |
| 17 | .89 | .69 | 1.05 | 1.04 | 1.44 | .99 | .81 | .63 | .56 | 1.26 | .71 | 1.27 |
| 18 | .88 | .71 | 1.04 | 1.03 | 1.37 | .97 | .79 | .61 | .56 | 1.24 | .74 | 1.34 |
| 19 | .86 | .76 | 1.05 | 1.08 | 1.29 | .94 | .77 | .59 | .57 | 1.17 | 1.15 | 1.38 |
| 20 | .87 | .74 | 1.10 | 1.46 | 1.25 | .98 | .75 | .58 | .58 | 1.11 | 1.10 | 1.42 |
| 21 | .86 | .77 | 1.17 | 1.51 | 1.32 | .95 | .73 | .58 | .57 | 1.07 | 1.04 | 1.38 |
| 22 | .86 | .74 | 1.26 | 1.49 | 1.42 | .92 | .72 | .58 | .55 | 1.03 | 1.02 | 1.32 |
| 23 | .88 | .76 | 1.30 | 1.47 | 1.91 | .90 | .71 | .57 | .53 | .99 | .98 | 1.28 |
| 24 | .99 | .78 | 1.50 | 1.47 | 2.74 | .89 | .71 | .50 | .54 | 1.02 | .94 | 1.35 |
| 25 | 1.03 | .77 | 1.55 | 1.54 | 2.46 | .92 | .70 | .56 | .60 | 1.47 | 1.30 | 1.37 |
| 26 | 1.02 | .76 | 1.57 | 1.55 | 2.13 | .91 | .70 | .56 | .63 | 1.49 | 1.60 | 1.71 |
| 27 | 1.40 | .74 | 1.61 | 1.46 | 1.95 | 1.00 | .69 | .56 | .60 | 1.41 | 1.65 | 1.79 |
| 28 | 1.66 | .83 | 1.54 | 1.39 | 1.96 | 1.22 | .69 | .58 | .60 | 1.29 | 1.54 | 1.65 |
| 29 | 1.69 | ....... | 1.46 | 1.28 | 1.91 | 1.19 | .69 | .58 | .61 | 1.23 | 1.39 | 1.53 |
| 30 | 1.55 | ....... | 1.33 | 1.18 | 1.80 | 1.06 | .68 | .58 | .60 | 1.15 | 1.29 | 1.49 |
| 31 | 1.43 | ....... | 1.26 | ....... | 1.75 | ....... | .68 | .58 | ....... | 1.09 | ....... | 1.39 |

## SNOHOMISH RIVER DRAINAGE BASIN.

Snoqualmie and Skykomish rivers unite to form the Snohomish, which flows into Puget Sound about 10 miles beyond the junction, near Everett, Wash. The Stilaguamish lies north of the Skykomish and has a parallel course.

### SOUTH FORK OF SKYKOMISH RIVER NEAR INDEX, WASH.

This station was established October 6, 1902, by T. A. Noble, and was discontinued September 30, 1905. It is located about 2 miles above Index and about 300 feet from the railroad track.

The channel is straight for 500 feet above and 300 feet below the station. Both banks are of solid rock and not liable to overflow. The bed of the stream is of sand and gravel, not liable to change except near the left bank, where the sand shifts at high water. This does not cause any important change in the cross section. This station is 300 feet upstream from Sunset Falls, where the river plunges down a solid granite ledge with a slope of about two horizontal to one vertical. The ledge answers the purpose of a spillway in regulating the flow of the river at the gaging station, since the water has a free discharge and a permanent bed just below the station.

Discharge measurements are made by means of a cable and car. The initial point for for soundings is on the left bank at a plug driven in the solid rock 10 feet from the edge of the stream at low water.

A staff gage is fastened to the solid rock A hook gage is used for reading to hundredths of a foot. During 1905 the gage was read once each day by Louis G. Heybrook. The bench mark is a cross cut in the rock about 6 feet above low water and 40 feet downstream from the gage; elevation, 9.232 feet above the datum of the gage and 679.158 feet above sea level, as obtained from the Great Northern Railway.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, p 222; 100, pp 471-472; 135, pp 278-279.
Discharge: 85, p 223.
Discharge, monthly: 100, p 474; 135, p 280.
Gage heights: 85, p 223; 100, pp 472-473; 135, p 279.
Rating table: 100, p 473; 135, p 280.

*Daily gage height, in feet, of South Fork of Skykomish River near Index, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.55 | 2.93 | 5.72 | 3.14 | 3.53 | 7.02 | 3.71 | 1.83 | 1.51 |
| 2 | 4.72 | 2.71 | 6.85 | 3.07 | 3.2 | 6.21 | 3.45 | 1.81 | 1.34 |
| 3 | 5.25 | 2.78 | 7.2 | 3.02 | 3.24 | 8.1 | 3.31 | 1.66 | 1.33 |
| 4 | 5.4 | 2.6 | 7.1 | 2.94 | 3.21 | 7.45 | 3.28 | 1.62 | 1.28 |
| 5 | 5.43 | 2.46 | 6.41 | 3.27 | 3.6 | 5.7 | 3.25 | 1.62 | 1.15 |
| 6 | 3.88 | 2.15 | 5.72 | 3.45 | 3.87 | 5.56 | 3.19 | 1.6 | 1.12 |
| 7 | 3.55 | 2.38 | 5.21 | 3.91 | 4.48 | 5.61 | 3.02 | 1.58 | 1.08 |
| 8 | 3.21 | 2.15 | 5.21 | 4.39 | 5.66 | 5.98 | 2.92 | 1.53 | 1.34 |
| 9 | 2.98 | 2.04 | 5.62 | 3.75 | 5.31 | 6.21 | 3.04 | 1.56 | 1.86 |
| 10 | 3.8 | 1.97 | 6.1 | 3.22 | 4.44 | 6.1 | 2.98 | 1.54 | 1.62 |
| 11 | 2.52 | 1.66 | 6.81 | 3.21 | 4.02 | 5.81 | 2.83 | 1.48 | 1.43 |
| 12 | 2.38 | 1.6 | 5.28 | 3.42 | 3.89 | 5.48 | 2.43 | 1.43 | 1.41 |
| 13 | 2.23 | 1.64 | 4.72 | 3.74 | 3.54 | 5.45 | 2.35 | 1.41 | 1.45 |
| 14 | 2.2 | 1.63 | 4.46 | 3.72 | 6.6 | 5.38 | 2.61 | 1.4 | 1.34 |
| 15 | 2.18 | 1.61 | 4.49 | 3.45 | 5.21 | 4.8 | 2.48 | 1.98 | 1.32 |
| 16 | 2.18 | 1.58 | 4.5 | 3.31 | 4.72 | 4.13 | 2.5 | 4.43 | 1.31 |
| 17 | 2.19 | 1.52 | 4.47 | 3.21 | 5.37 | 4.23 | 2.48 | 4.74 | 1.56 |
| 18 | 2.12 | 1.45 | 4.71 | 3.47 | 4.42 | 4.32 | 2.29 | 3.16 | 2.21 |

*Daily gage height, in feet, of South Fork of Skykomish River near Index, Wash., for 1905.*—Continued.

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 19 | 2.22 | 2.12 | 4.51 | 4.0 | 4.25 | 4.29 | 2.22 | 2.32 | 2.0 |
| 20 | 2.2 | 2.4 | 4.34 | 4.62 | 4.14 | 4.41 | 2.26 | 2.17 | 3.81 |
| 21 | 2.08 | 3.1 | 4.61 | 4.63 | 4.09 | 4.35 | 2.34 | 1.9 | 2.74 |
| 22 | 2.18 | 4.48 | 4.48 | 5.12 | 4.25 | 4.12 | 2.31 | 1.68 | 2.45 |
| 23 | 2.31 | 5.0 | 4.48 | 5.52 | 4.32 | 3.91 | 2.19 | 1.53 | 2.7 |
| 24 | 3.02 | 5.4 | 4.92 | 6.13 | 4.81 | 3.81 | 2.12 | 1.45 | 2.85 |
| 25 | 3.2 | 7.75 | 4.94 | 6.58 | 4.56 | 3.49 | 2.0 | 1.21 | 2.9 |
| 26 | 2.92 | 5.12 | 4.73 | 6.22 | 4.78 | 4.06 | 1.94 | 1.18 | 6.55 |
| 27 | 6.18 | 5.21 | 4.2 | 6.2 | 5.38 | 4.82 | 1.88 | 1.23 | 4.8 |
| 28 | 5.95 | 5.58 | 4.15 | 4.5 | 5.69 | 4.51 | 2.03 | 1.19 | 3.82 |
| 29 | 4.10 | ........ | 3.81 | 3.98 | 5.89 | 4.34 | 1.98 | 1.25 | 3.76 |
| 30 | 3.78 | ........ | 3.48 | 3.62 | 6.41 | 3.81 | 1.95 | 1.28 | 3.85 |
| 31 | 3.31 | ........ | 3.24 | ........ | 7.12 | ........ | 1.91 | 2.0 | ........ |

## SNOQUALMIE RIVER NEAR SNOQUALMIE FALLS, WASH.

This station was originally established by T. A. Noble September 14, 1902, and was discontinued September 30, 1905. The gage was originally located below the falls, but was destroyed by the flood of December 1, 1902. November 2, 1902, another gage was placed about 3 miles above Snoqualmie Falls post-office.

The right bank is high and never overflows; the left bank overflows at extreme high water. The bed of the stream is of gravel and sand and is not liable to shift. The station is located below the junction of the north, south, and middle forks of Snoqualmie River. At Snoqualmie Falls, about 4 miles below this station, the river flows over a precipice 268 feet high. Above the falls the Snoqualmie Falls Power Company has built a dam and water-power plant. The slack water from this dam reaches back from the falls about 3 miles, and probably affects the flow of the river slightly at the gaging station. This is the only possible location for a gaging station which will include all three forks of the river.

Discharge measurements are made by means of a cable and car. The initial point for soundings is a spike driven into a large maple stump on the right bank, about 4 feet above the ground.

The present gage, established January 7, 1903, is in two sections. During 1905 the gage was read once each day by E. C. Reinig. The bench mark is the initial point for soundings; elevation, 27.83 feet above the datum of the gage.

Information in regard to this station is contained in the following Water-Supply Papers of the United States Geological Survey:

Description: 85, pp 220-221; 100, pp 468-469; 135, p 281.
Discharge: 85, p 221; 100, p 469.
Discharge, monthly: 100, p 471; 135, p 284.
Gage heights: 85, pp 221-222; 100, pp 469-470; 135, p 282.
Rating table: 100, p 470; 135, p 283.

*Daily gage height, in feet, of Snoqualmie River near Snoqualmie Falls, Wash., for 1905.*

| Day. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.93 | 2.96 | 6.23 | 3.0 | 3.01 | 6.13 | 2.71 | 1.24 | 1.05 |
| 2 | 5.73 | 2.75 | 7.85 | 2.97 | 3.67 | 5.1 | 2.64 | 1.19 | .93 |
| 3 | 6.15 | 2.63 | 6.54 | 2.84 | 2.59 | 7.37 | 2.51 | 1.13 | .85 |
| 4 | 4.77 | 2.44 | 5.6 | 2.06 | 2.53 | 6.7 | 2.44 | 1.09 | .83 |
| 5 | 4.21 | 2.31 | 5.13 | 3.28 | 2.61 | 6.17 | 2.37 | 1.05 | .79 |
| 6 | 3.55 | 2.2 | 4.46 | 3.31 | 2.97 | 5.45 | 2.29 | 1.0 | .75 |
| 7 | 3.33 | 2.23 | 4.31 | 3.59 | 4.02 | 5.2 | 2.2 | .99 | .71 |
| 8 | 3.05 | 2.26 | 3.98 | 3.23 | 4.38 | 4.99 | 2.19 | 1.0 | .92 |
| 9 | 2.8 | 2.19 | 4.21 | 3.02 | 5.06 | 4.92 | 2.21 | .98 | 1.02 |
| 10 | 2.61 | 2.11 | 4.5 | 2.85 | 5.0 | 4.87 | 2.12 | .96 | .98 |
| 11 | 2.43 | 2.05 | 4.21 | 2.81 | 5.23 | 4.61 | 1.97 | .94 | .9 |
| 12 | 2.16 | 1.87 | 3.94 | 2.79 | 6.62 | 3.92 | 1.82 | .9 | .85 |
| 13 | 2.0 | 1.63 | 3.67 | 3.24 | 7.21 | 3.75 | 1.74 | .85 | 1.1 |
| 14 | 2.19 | 1.6 | 3.56 | 3.12 | 7.42 | 3.41 | 1.98 | .8 | 1.25 |
| 15 | 2.27 | 1.58 | 3.4 | 2.97 | 5.29 | 3.32 | 2.21 | .82 | 1.11 |
| 16 | 2.38 | 1.55 | 3.49 | 2.84 | 4.41 | 3.16 | 2.52 | 1.45 | 1.23 |
| 17 | 2.35 | 1.54 | 3.58 | 3.19 | 4.22 | 3.09 | 2.58 | 4.41 | 1.45 |
| 18 | 2.33 | 1.84 | 3.4 | 3.47 | 4.12 | 3.01 | 2.34 | 2.62 | 2.08 |
| 19 | 2.2 | 2.63 | 3.91 | 3.64 | 4.02 | 2.93 | 2.29 | 2.31 | 1.85 |
| 20 | 2.19 | 3.22 | 4.1 | 3.89 | 3.96 | 2.94 | 2.17 | 1.87 | 2.61 |
| 21 | 2.18 | 4.3 | 4.35 | 4.23 | 3.81 | 2.92 | 2.03 | 1.82 | 2.12 |
| 22 | 2.21 | 4.43 | 4.56 | 4.45 | 4.61 | 2.91 | 1.92 | 1.72 | 1.8 |
| 23 | 2.45 | 4.61 | 4.61 | 4.97 | 5.3 | 2.89 | 1.8 | 1.56 | 1.71 |
| 24 | 4.1 | 6.2 | 4.79 | 5.21 | 8.05 | 2.9 | 1.73 | 1.42 | 1.92 |
| 25 | 3.82 | 5.69 | 4.69 | 5.26 | 7.01 | 2.91 | 1.58 | 1.36 | 2.0 |
| 26 | 4.67 | 5.20 | 4.5 | 4.92 | 5.68 | 2.99 | 1.45 | 1.21 | 5.62 |
| 27 | 5.82 | 4.27 | 4.34 | 4.92 | 5.63 | 3.32 | 1.43 | 1.16 | 4.27 |
| 28 | 5.89 | 4.36 | 3.92 | 3.63 | 5.6 | 3.21 | 1.41 | 1.02 | 3.35 |
| 29 | 4.53 | ........ | 3.61 | 3.42 | 5.57 | 2.96 | 1.38 | 1.07 | 3.27 |
| 30 | 3.97 | ........ | 3.29 | 3.0 | 5.53 | 2.81 | 1.32 | 1.09 | 3.16 |
| 31 | 3.34 | ........ | 3.13 | ........ | 5.5 | ........ | 1.27 | 1.06 | ........ |

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# CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 178.]

The publications of the United States Geological Survey consist of (1) Annual Reports, (2) Monographs, (3) Professional Papers, (4) Bulletins, (5) Mineral Resources, (6) Water-Supply and Irrigation Papers, (7) Topographic Atlas of United States—folios and separate sheets thereof, (8) Geologic Atlas of United States—folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists may be had on application.

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*Series P.*—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements. A detailed index of these reports (1888–1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II.
1889. Eleventh Annual Report, Part II.
1890. Twelfth Annual Report, Part II.
1891. Thirteenth Annual Report, Part III.
1892. Fourteenth Annual Report, Part II.
1893. Bulletin No. 181.
1894. Bulletin No. 131; Sixteenth Annual Report, Part II.
1895. Bulletin No. 140.
1896. Water-Supply Paper No. 11; Eighteenth Annual Report, Part IV.
1897. Water-Supply Papers Nos. 15 and 16; Nineteenth Annual Report, Part IV.
1898. Water-Supply Papers Nos. 27 and 28; Twentieth Annual Report, Part IV.
1899. Water-Supply Papers Nos. 35, 36, 37, 38, and 39; Twenty-first Annual Report, Part IV.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65 and 75.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers, Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Nos. 165, 166, 167, 168, 169, 170, and 171.
West of Mississippi River, Nos. 171, 172, 173, 174, 175, 176, 177, and 178.

The Geological Survey and the Reclamation Service have suboffices in different parts of the United States, from which hydrographic and reclamation work in the respective localities is carried on, and where data may be obtained on application. These offices are located as follows:

Boston, Mass., 6 Beacon street; Utica, N. Y., 75 Arcade; Atlanta, Ga., 409 Temple court; Austin, Tex., University of Tex.; Chicago, Ill., 876 Federal Building; Belle Fourche, S. Dak.; Cody, Wyo.; Denver, Colo., Chamber of Commerce Building; Salt Lake, Utah; Los Angeles, Cal., 1108 Union Trust Building; Phoenix, Ariz.; Carlsbad, N. Mex.; El Paso, Tex.; Billings, Mont.; Huntley, Mont.; Hazen, Nev.; Boise, Idaho; North Yakima, Wash.; Portland, Oreg., 351 Washington street.

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